

REPORT ON REVISIONS TO
5TH EDITION AP-42
Section 1.7
Lignite Combustion

Prepared for:

Contract No. 68-D2-0160, Work Assignment 50
EPA Work Assignment Officer: Roy Huntley
Office of Air Quality Planning and Standards
Office of Air and Radiation
U. S. Environmental Protection Agency
Research Triangle Park, North Carolina 27711

Prepared by:

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Morrisville, North Carolina 27560

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Table of Contents

| | Page |
|--|------|
| 1.0 INTRODUCTION | 1-1 |
| 2.0 REVISIONS | 2-1 |
| 2.1 General Text Changes | 2-1 |
| 2.2 Nitrogen Oxides, NO _x | 2-1 |
| 2.2.1 Uncontrolled NO _x | 2-1 |
| 2.2.2 Controlled NO _x | 2-1 |
| 2.3 Sulfur Oxides, SO _x | 2-2 |
| 2.3.1 Uncontrolled SO _x | 2-2 |
| 2.3.2 Controlled SO _x | 2-2 |
| 2.4 Carbon Monoxide, CO | 2-3 |
| 2.4.1 Uncontrolled CO | 2-3 |
| 2.4.2 Controlled CO | 2-3 |
| 2.5 Particulate Matter, PM | 2-4 |
| 2.5.1 Uncontrolled PM | 2-4 |
| 2.5.2 Controlled PM | 2-4 |
| 2.6 Particle Size Distribution | 2-4 |
| 2.7 Trace Metals and Polycyclic Organic Matter (POM) | 2-5 |
| 2.8 Greenhouse Gases | 2-5 |
| 2.8.1 Carbon Dioxide, CO ₂ | 2-5 |
| 2.8.2 Methane, CH ₄ | 2-6 |
| 2.8.3 Nitrous Oxide, N ₂ O | 2-6 |
| 2.9 Toxic Air Pollutants | 2-6 |
| 2.9.1 General Document Evaluation and Emission Factor Development .. | 2-7 |
| 2.9.2 Description of Documents Evaluated | 2-9 |
| 2.9.3 Emission Factor Development | 2-33 |
| 3.0 REFERENCES | 3-1 |
| 4.0 REVISED SECTION 1.7 | 4-1 |
| 5.0 EMISSION FACTOR DOCUMENTATION, APRIL 1993 | 5-1 |
| APPENDIX A | 5-2 |

1.0 INTRODUCTION

This report supplements the Emission Factor (EMF) Documentation for AP-42 Section 1.7, Lignite Combustion, dated April 1993. The EMF describes the source and rationale for the material in the most recent updates to the 4th Edition, while this report provides documentation for the updates written in both Supplements A and B to the 5th Edition.

Section 1.7 of AP-42 was reviewed by internal peer reviewers to identify technical inadequacies and areas where state-of-the-art technological advances needed to be incorporated. Based on this review, text was updated or modified to address any technical inadequacies or provide clarification.

Emission factors were checked for accuracy with information in the EMF Document, and new emission factors generated if recent test data were available. If discrepancies were found when checking the factors with the information in the EMF Document, the appropriate reference materials were then checked. In some cases, the factors could not be verified with the information in the EMF Document or from the reference materials, in which case the factors were not changed.

Four sections follow this introduction. Section 2 of this report documents the revisions and the basis for the changes. Section 3 presents the references for the changes documented in this report. Section 4 presents the revised AP-42 Section 1.7, and Section 5 contains the EMF documentation dated April 1993.

2.0 REVISIONS

2.1 General Text Changes

Information in the EMF Document and the Utility Boiler Alternative Control Techniques (ACT) Document¹ was used to enhance text concerning lignite characteristics; firing practices, emissions and controls. Additionally, at the request of EPA, the metric units were removed.

2.2 Nitrogen Oxides, NO_x

2.2.1 Uncontrolled NO_x

The factors were checked against information in Tables 4-2, 4-4, 4-6, and 4-9 of the EMF Document and the 9/88 version of Section 1.7 and no changes were required.

2.2.2 Controlled NO_x

The controlled NO_x emission factors were changed from two categories of NO_x controls (tangential boilers with overfire air and tangential boilers with overfire air plus low NO_x burners) to three categories based on information in Table 4-10 of the EMF Document. The three categories of boilers and NO_x controls are Subpart D tangential boilers with overfire air; Subpart D wall-fired boilers with overfire air plus low NO_x burners; and Subpart Da tangential boilers with overfire air. The changes made are shown in the following table:

NO_x Emission Factors for Controlled Lignite Boilers

| Firing Configuration and NO _x Control | Revised NO _x Emission Factor (lb/ton) | Emission Factor Rating |
|---|--|------------------------------|
| Subpart D boilers, pulverized coal, tangential-fired overfire air | 6.8 | C |
| Subpart D boilers, pulverized coal, wall-fired, overfire air plus low NO _x burners | 4.6 | C |
| Subpart Da boilers, pulverized coal, tangential-fired overfire air | 6.0 | C |

2.3 Sulfur Oxides, SO_x

2.3.1 Uncontrolled SO_x

The factors were checked against information in Tables 4-1 and 4-9 of the EMF Document and the 9/88 version of Section 1.7 and the following typographical error was corrected for the Atmospheric Fluidized Bed Boiler category:

| Source Category | Previous Factor (lb/ton) | Revised Factor (lb/ton) |
|---------------------------|--------------------------|-------------------------|
| Atmospheric Fluidized Bed | 30S | 10S |

2.3.2 Controlled SO_x

Table 4-10 of the EMF Document contained SO_x emission factors for various lignite boilers with SO_x controls; however, this data was not included in the 4/93 version of AP-42. The data were divided into four categories according to boiler age (i.e., Subpart D or Da) and SO_x control type (i.e., spray dryer or wet scrubber). The emission factors added are shown in the following table:

SO_x Emission Factors for Controlled Lignite Boilers

| Boiler Type and SO _x Control | SO _x Emission Factor (lb/ton) | Rating |
|--|--|--------|
| Subpart D, pulverized coal, tangential and wall-fired, spray dryer | 7.3S | D |
| Subpart D, pulverized coal, tangential-fired, wet scrubber | 16.8S | C |
| Subpart Da, pulverized coal, tangential-fired spray dryer | 7.9S | D |
| Subpart Da, pulverized coal, tangential-fired, wet scrubber | 3.7S | C |

2.4 Carbon Monoxide, CO

2.4.1 Uncontrolled CO

The factors were checked against information in Tables 4-2, 4-9, and 4-10 of the EMF Document and the 10/86 version of AP-42 and no changes were required.

2.4.2 Controlled CO

The controlled CO emission factors were changed from two categories (tangential boilers with overfire air and tangential boilers with overfire air plus low NO_x burners) to three categories based on information in Table 4-10 of the EMF Document. Three categories of boilers and NO_x controls are Subpart D tangential boilers with overfire air; Subpart D wall-fired boilers with overfire air plus low NO_x burners; and Subpart Da tangential boilers with overfire air. (NO_x controls may affect CO emission whereas SO₂ controls should not.) The changes made are shown in the following table:

CO Emission Factors for Controlled Lignite Boilers

| Firing Configuration and NO _x Control | Revised CO Emission Factor (lb/ton) | Emission Factor Rating |
|---|-------------------------------------|------------------------|
| Subpart D boilers, pulverized coal, tangential-fired overfire air | No data | Not applicable |
| Subpart D boilers, pulverized coal, wall-fired, overfire air plus low NO _x burners | 0.48 | D |
| Subpart Da boilers, pulverized coal, tangential-fired, overfire air | 0.1 | D |

2.5 Particulate Matter, PM

2.5.1 Uncontrolled PM

The uncontrolled PM emission factors were checked against information in Tables 4-3, 4-5, 4-7, and 4-8 of the EMF Document and no changes were required.

2.5.2 Controlled PM

The controlled PM emission factors were checked against information in Tables 4-12 and 4-13 of the EMF Document and no changes were required.

2.6 Particle Size Distribution

The particle size factors remain the same as in the 10/86 version of AP-42.

2.7 Trace Metals and Polycyclic Organic Matter (POM)

These emission factors were checked against information in Tables 4-18, 4-19, and 4-20 of the EMF Document and no changes were required. However, the controlled emission factors for those metals were replaced with new factors. See Section 2.9, Toxic Air Pollutants.

2.8 Greenhouse Gases

2.8.1 Carbon Dioxide, CO₂

CO₂ emission factors for Table 1.7-2 were developed assuming 99 percent conversion of fuel carbon content to carbon dioxide during combustion.²⁻⁴ An emission factor of 72.6C, where C is carbon content (weight percentage based on an ultimate analysis, dry basis), was developed using the following equation:

$$\frac{44 \text{ ton CO}_2}{12 \text{ ton C}} \times 0.99 \times 2000 \frac{\text{lb CO}_2}{\text{ton CO}_2} \times \frac{1}{100\%} = 72.6 \frac{\text{lb CO}_2}{\text{ton} - \%C}$$

Where: 44 = molecular weight of CO₂;
12 = molecular weight of carbon; and
0.99 = fraction of fuel oxidized during combustion (Reference 2-4).

If an ultimate analysis is not available, a default CO₂ emission factor was computed based on the emission factor equation presented above and the average carbon content (dry basis) for several U.S. lignite samples.⁵⁻⁸ Because of the variance of carbon content with the geographical location of the mine, this default factor was assigned a "B" rating.

Table 3-2. Default CO₂ Emission Factors for U.S. Coals
Quality Rating: B

| Fuel Type | Average %C^a | Conversion Factor | Emission Factor (lb/ton coal) |
|------------------|-----------------------------------|--------------------------|--|
| Lignite | 63.4 | 72.6 | 4600 |

^a An average of the values given in References 5-8. Each of these references listed average carbon contents based on extensive sampling of U.S. coals.

2.8.2 Methane, CH₄

No emissions data were located.

2.8.3 Nitrous Oxide, N₂O

No emissions data were located.

2.9 Toxic Air Pollutants

An evaluation of toxic emissions data resulted in the development of new factors that were added to the section. In addition, the evaluation resulted in the replacement of controlled emission factors for chromium and manganese because the new factors were of higher quality. Most of the emissions data were stack test reports that presented emission factors, or reports that presented emissions and process data from which emission factors were developed. The following sections describe the documents evaluated and the methods used to develop the toxic emission factors.

2.9.1 General Document Evaluation and Emission Factor Development

Section 1.1, Bituminous And Subbituminous Coal Combustion and Section 1.7, Lignite Combustion were updated simultaneously and, therefore, emissions data from both types of combustion were of interest during the emissions data evaluation. Originally, the intent was to develop separate emission factors for the two sections, but after all data were assembled and examined, the emission factors for the two types of combustion were very similar in value. Because the factors were similar, it was decided to combine all data and develop one set of emission factors that would represent bituminous/subbituminous coal combustion as well as lignite combustion.

The focus of the emissions data evaluation was on toxic air pollutants, especially metals. Several documents provided emissions data for compounds that are not considered hazardous air pollutants and these data were not used to develop emission factors. Because of the limited scope of the emission factor development project, some data for toxic air pollutants were not used. Emissions data for radionuclides were encountered but were not used because the list of potential radionuclide emission factors is quite extensive. Emissions data for dioxins/furans were not used unless data for all congeners was included.

Because of budget constraints, the document evaluation concentrated on air emissions, or final stack emissions, only. Emissions data obtained from sampling at control device inlets, or outlets of intermediate control devices, were not used to develop emission factors.

Following EPA guidance, the emission factors developed for Section 1.7 of AP-42 are expressed in units of pound of pollutant emitted per ton of coal fired (lb/ton). Thus, the emissions documents were evaluated in order to identify emission factors, or information from which emission factors could be developed, in units of lb/ton. Many of the documents presented emission factors, but they were in units of pound of pollutant emitted per million British thermal units of heat input (lb/MMBtu). In such cases, a higher heating value (HHV)

for coal in units of Btu/lb was used to convert the factor to units of lb/ton. Several of the documents provided emissions and process information, such as emission rates and coal feed rates, that were used to develop emission factors. Some of the documents provided coal data, such as the HHV and coal feed rate, on a dry-basis. When the moisture content of the coal was provided, the dry-basis data were converted to as-fired, or as-received, data. The methods used for each document to develop the emission factors are described in Section 2.9.2, Description Of Documents Evaluated.

The majority of the documents evaluated were emissions test reports obtained from various sources. One source of emissions information was test reports provided by the Electric Power Research Institute (EPRI) and the U.S. Department of Energy (DOE). EPRI and DOE conducted an extensive emissions test program at several coal-fired power plants in order to characterize their emissions. Most of the individual facility test reports and the summary report of the test program were provided to EPA for use in emission factor development.

Another source of information was several emissions test reports from coal-fired power plants provided to EPA by the Northern States Power Company (NSP). In addition, several test reports obtained by EPA from other sources were evaluated.

A computer spreadsheet was constructed for each document where calculations were required to develop and characterize emission factors from information presented in the document. A spreadsheet was created for every reference except Reference 9. Reference 9 is a summary of an emissions test program conducted by EPRI and DOE. The spreadsheets were used as mathematical tools and as a means of documenting all calculations and assumptions. Also, information from each document that was used to characterize the emission factors was included in the spreadsheets. For example, information provided about the boiler(s) tested was used to assign a source classification code (SCC). In addition, any control devices in use by the emission source were noted. Copies of each computer spreadsheet are included in Appendix A.

When assigning SCCs to an emission source described in a reference, the boiler was assumed to be dry bottom unless the document specified that the boiler was wet bottom or mentioned an ash removal method that would be indicative of a wet bottom boiler. All emission controls described by the reference as being in use at the time the emissions data were collected were noted and no attempt was made to judge the effect of a control device on any of the sampled pollutants. Emissions data were not characterized as "uncontrolled" unless there was no type of pollution control device at all in use when the emissions data were collected.

2.9.2 Description of Documents Evaluated

The following paragraphs provide a summary of the information presented in each document that was evaluated for emission factors. Also, the methods used to develop emission factors from the information provided in each document are described. Copies of the computer spreadsheets that were constructed for each document (except Reference 9) are contained in Appendix A. The text descriptions are provided as a supplement to the spreadsheets in order to ensure that the development of all emission factors is fully explained.

Reference 9

This document summarizes the results of the emissions test program conducted by EPRI and DOE. This document presents emission factor equations for nine trace metals and emission factors for five organic pollutants that were developed from emissions data collected during the test program. The emission factor equations were judged to be of sufficient quality for inclusion in AP-42 and are presented there "as is," i.e. no adjustments or conversions were made. The organic emission factors were not used for AP-42 because they are a geometric, instead of arithmetic, mean. The reference was assigned a data quality rating of "A." The emission factor equations are discussed in detail in Section 2.9.3, Emission Factor Development.

Reference 10

This document presents the results of two emissions tests conducted at the NSP Sherco plant in Becker Minnesota. One emission test was conducted on Unit Three, which is a Babcock and Wilcox (B&W) 860 MW boiler firing pulverized subbituminous coal from Montana. Unit Three came on line in 1987. Emission controls utilized during the test were a spray dryer absorber and a baghouse.

The second emissions test was performed simultaneously on Units One and Two, which are identical Combustion Engineering 750 MW boilers that came on line in 1976. During the tests, both boilers were firing 70 percent Wyoming and 30 percent Montana pulverized subbituminous coal. Emissions from Units One and Two were controlled by a venturi scrubber spray tower during the emissions tests.

Both emissions tests consisted of three sampling runs for mercury and the results are presented as emission rates in units of lb/hr. The reference indicates that all sampling results were above the detection limits. In addition, the document presents the coal feed rates in ton/hr during both tests. Mercury emission factors in units of lb/ton were developed by dividing the emission rates by the coal feed rates.

The document was assigned a data quality rating of "A."

Reference 11

This reference presents the results of an emissions test conducted simultaneously on the Number One, Number Three, and Number Four boilers at the NSP Black Dog Plant located in Burnsville, Minnesota. The boilers are water tube boilers and were fired with pulverized subbituminous coal from the Antelope and North Antelope mines during the test. Emission controls utilized during the test were two electrostatic precipitators (ESPs) in series.

The emissions test consisted of three sampling runs for metals and the results are presented as emission rates in units of lb/hr. Full detection limit values were used to develop emission rates for pollutants that were not detected in any sampling run. Stack gas volumetric flow rates presented in the report (dscf/hr) and an average F-factor for coal of 9,780 dscf/MMBtu were used to develop an energy input rate in units of MMBtu/hr. The reference provides an HHV for the coal fired during the emissions test of 8,707 Btu/lb on an as-received basis. This value was used to convert the energy input rate to a coal feed rate in ton/hr. The emission rates were divided by the coal feed rate to arrive at emission factors in units of lb/ton.

The document was assigned a data quality rating of "B" because the coal feed rates during the emissions test were not provided.

Reference 12

The results of an emissions test conducted on the Number Two boiler at the NSP Black Dog plant in Burnsville, Minnesota, are presented in this report. The Number Two boiler is a 137 MW Foster-Wheeler atmospheric fluidized bed combustor (AFBC). At the time of the emissions test, Unit Two was firing 100 percent Western coal (blend of Antelope and Northern Antelope), which is subbituminous coal. Emission control devices in use during the test were a mechanical dust collector and two ESPs in series.

Three sampling runs were conducted for metals and the results are presented as emission rates in units of lb/hr. Full detection limit values were used to develop emission rates for pollutants that were not detected in any sampling run. Stack gas volumetric flow rates (dscf/hr) provided in the document and an average F-factor for coal of 9,780 dscf/MMBtu were used to develop an energy input rate in units of MMBtu/hr. The reference provides an HHV for the coal fired during the emissions test of 8,553 Btu/lb on an as-received basis. This

value was used to convert the energy input rate to a coal feed rate in ton/hr. The emission rates were divided by the coal feed rates to arrive at emission factors in units of lb/ton.

The reference was assigned a data quality rating of "B" because the coal feed rates during the emissions test were not provided.

Reference 13

This reference presents the results of an emissions test conducted simultaneously on the Number Three, Number Four, Number Five, and Number Six boilers at the NSP High Bridge plant in St. Paul, Minnesota. All of these boilers are B & W boilers and are equipped to fire pulverized coal. During the test, the boilers were fired with subbituminous coal from the Rochelle mine. A coldside ESP was in use during the emissions test.

Three sampling runs were conducted for metals, benzene, toluene, ethylbenzene, and xylene and the results are presented as emission rates in units of lb/hr. All sampling results for metals were above the detection limits. Benzene, toluene, ethylbenzene, and xylene were not detected in any sampling run and no emission factors for these pollutants were developed. Stack gas volumetric flow rates (dscf/hr) provided in the document and an average F-factor for coal of 9,780 dscf/MMBtu were used to develop an energy input rate in MMBtu/hr. The reference presents an HHV for the coal fired during the emissions test of 8,498 Btu/lb on an as-received basis. This value was used to convert the energy input rate to a coal feed rate in ton/hr. The emission rates were divided by the coal feed rates to arrive at emission factors in units of lb/ton.

This reference was assigned a data quality rating of "B" because the coal feed rates during the emissions test were not provided.

Reference 14

This document presents the results of emissions tests conducted on the Units Six and Seven at the NSP Riverside plant in Minneapolis, Minnesota. These boilers are pulverized coal-fired boilers and were firing subbituminous coal from the Rochelle mine during the emissions tests. Emission controls in use during the test consisted of a baghouse.

Three sampling runs were conducted for metals, benzene, toluene, ethylbenzene and xylene. For metals, the emissions data from both units were combined and presented as emission rates in units of lb/hr. The benzene, toluene, ethylbenzene and xylene emissions data are presented separately for each unit as emission rates in lb/hr. All sampling results for metals were above the detection limits. Toluene, ethylbenzene, and xylene were not detected in any sampling run and no emission factors for these pollutants were developed. Stack gas volumetric flow rates (dscf/hr) provided in the document and an average F-factor for coal of 9,780 dscf/MMBtu were used to develop an energy input rate in MMBtu/hr. The reference provides an HHV for the coal fired during the emissions test of 8,602 Btu/lb on an as-received basis. This value was used to convert the energy input rate to a coal feed rate in ton/hr. The emission rates were divided by the coal feed rates to arrive at emission factors in units of lb/ton.

The reference was assigned a data quality rating of "B" because the coal feed rates during the emissions test were not provided.

Reference 15

The results of an emissions test conducted simultaneously on Units One and Two at the NSP Sherburne County Generating Station located in Becker, Minnesota, are presented in this reference. The units are identical Combustion Engineering 750 MW boilers which came on line in 1976 and were fired with 80 percent Rochelle and 20 percent Coalstrip pulverized

subbituminous coal during the test. The boilers were controlled by a wet limestone scrubbing system consisting of twelve individual rod venturi scrubber spray towers during the test.

Three sampling runs were conducted for metals and the results are presented as emission rates in units of lb/hr. Full detection limit values were used to calculate emission rates for pollutants that were not detected in any sampling run. Stack gas volumetric flow rates (dscf/hr) provided in the document and an average F-factor for coal of 9,780 dscf/MMBtu were used to develop an energy input rate in MMBtu/hr. The reference provides an HHV for the coal fired during the emissions test of 8,547 Btu/lb on an as-received basis. This value was used to convert the energy input rate to a coal feed rate in ton/hr. The emission rates were divided by the coal feed rates to arrive at emission factors in units of lb/ton.

The reference was assigned a data quality rating of "B" because the coal feed rates during the emissions test were not provided.

Reference 16

This document presents the results of an emissions test conducted simultaneously on Units One and Two at the NSP Sherburne County Generating Station located in Becker, Minnesota. The units are identical Combustion Engineering 750 MW boilers which came on line in 1976. The document does not specify the type of coal being fired during the tests. One other test report from this facility is included in this documentation (Reference 15) and the boilers were firing pulverized subbituminous coal during that test. Thus, it was assumed that the boilers were firing pulverized subbituminous coal during the tests described in this reference. Emissions were controlled by a wet limestone scrubbing system consisting of 12 individual rod venturi scrubber spray towers during the emissions test.

Three sampling runs were conducted for metals and the results are presented as emission rates in units of lb/hr. Full detection limit values were used to develop emission rates

for pollutants that were not detected in any sampling run. Stack gas volumetric flow rates (dscf/hr) provided in the document and an average F-factor for coal of 9,780 dscf/MMBtu were used to develop an energy input rate in MMBtu/hr. The reference does not provide an HHV for the coal fired during the emissions test and, therefore, an HHV for coal of 8,547 Btu/lb presented in Reference 15 (test report from the same facility) was used to convert the energy input rate to a coal feed rate in ton/hr. The emission rates were divided by the coal feed rates to arrive at emission factors in units of lb/ton.

The reference was assigned a data quality rating of "B" because the coal feed rates during the emissions test were not provided.

Reference 17

The results of an emissions test conducted on Unit Three at the NSP Sherburne County Generating Station located in Becker, Minnesota, are presented in this document. Unit Three is a B & W 860 MW boiler which came on line in 1987 and was fired with pulverized subbituminous coal from Montana during the emissions test. The boiler was controlled by a spray dryer absorber and a baghouse during the emissions test.

Three sampling runs were conducted for metals and the results are presented as emission rates in units of lb/hr. Full detection limit values were used to develop emission rates for pollutants that were not detected in any sampling run. Stack gas volumetric flow rates (dscf/hr) provided in the document and an average F-factor for coal of 9,780 dscf/MMBtu were used to develop an energy input rate in MMBtu/hr. The document does not provide an HHV for the coal fired during the test and, therefore, an HHV for coal of 8,547 Btu/lb presented in Reference 15 (test report from the same facility) was used to convert the energy input rate to a coal feed rate in ton/hr. The emission rates were divided by the coal feed rates to arrive at emission factors in units of lb/ton.

The reference was assigned a data quality rating of "B" because the coal feed rates during the emissions test were not provided.

Reference 18

This reference presents the results of emission testing at a facility designated as EPRI Site 10. The boiler at this site is a fluidized bed combustor capable of producing approximately 100 MW of power at full load. According to the EPRI Synthesis Report (Reference 9), the boiler is a circulating bed AFBC and was firing subbituminous coal during the tests. Emission controls utilized during the tests were flue gas desulfurization (FGD) by limestone injection into the boiler combustion chamber and a fabric filter.

Test sampling runs were conducted for metals and organics. Because of a forced boiler outage, only one sampling run was conducted for all compounds except benzene. Five samples for benzene were collected at a later date. Full detection limit values were used to develop emission factors for pollutants that were not detected in any sampling run.

Emissions test results for dibutyl phthalate, bis(2-ethylhexyl), and N-nitrosodimethylamine are presented as concentrations in units of microgram per cubic Normal cubic meter. The reference indicates that all sampling results for these pollutants were above the detection limits. The concentrations were converted to units of pounds per dry standard cubic feet (lb/dscf) and multiplied by the stack gas volumetric flow rate (dscf/hr) to arrive at an emission rate in lb/hr. The reference presents a dry-basis coal feed rate of 108,626 lb/hr during the test and a coal moisture percent of 7.3. The dry coal feed rate was divided by 100 percent minus 7.3 percent (92.7 percent) to obtain a coal feed rate, as fired, of 117,180 lb/hr. The emission rates for the three pollutants were divided by the coal feed rate, as fired, to obtain emission factors in units of lb/ton.

The emissions results for the other compounds are presented as emission factors in units of lb/10¹² Btu. Full detection limit values were used to develop emission factors that are based only on sampling results that were below detection limits. The reference presents an HHV for the coal of 11,000 Btu/lb on a dry basis. The dry-basis HHV was divided by 100 percent plus 7.3 percent (107.3 percent) to obtain a HHV of 10,252 Btu/lb for the coal, as fired. The as-fired coal HHV was used to convert the emission factors in units of lb/10¹² Btu to factors in units of lb/ton.

This reference was assigned a data quality rating of "A."

Reference 19

This document presents the results of emissions testing at a facility designated as EPRI Site 11. The boiler tested is a 700 MW Combustion Engineering dry bottom, tangentially-fired unit with pulverized subbituminous coal from the Power River basin. Emission controls utilized during the test were over-fire air, an ESP, and a wet limestone scrubber/absorber.

Three sampling runs were conducted for metals, formaldehyde, and naphthalene and the results are presented as emission factors in units of lb/MMBtu. However, Run Three was invalid because of suspected contamination. For Run One, the vapor phase samples were lost and, therefore, were not analyzed. Emissions results for the solid phase of Run One and the Run Two solid and vapor phase results were used to calculate the average emission factors presented in the report. Rather than convert the emission factors presented in the reference from lb/10¹² Btu to lb/ton, the data from Run Two were used to develop emission factors. Pollutant concentrations in ug/Nm³ provided in the report for Run Two were converted to lb/dscf and then multiplied by the stack gas volumetric flow rate (dscf/hr) provided in the report to obtain emission rates in lb/hr. Full detection limit values were used to develop emission rates for pollutants that were not detected. An F-factor for coal of 9,780 dscf/MMBtu and the stack gas volumetric flow rate (dscf/hr) were used to calculate an

energy input rate in MMBtu/hr. The reference presents an HHV for the coal fired during the emissions test of 8,300 Btu/lb, as received. This value was used to convert the energy input rate to a coal feed rate in ton/hr. The pollutant emission rates were divided by the coal feed rate to obtain emission factors in units of lb/ton.

This reference was assigned a data quality rating of "B" because the coal feed rate was not provided.

Reference 20

The results of emissions testing at a facility designated as EPRI Site 12 are presented in this report. The boiler at Site 12 is an approximately 700 MW which commenced commercial operation in the mid-1980's. The boiler is a B & W balanced draft, opposed-wall, natural circulation, pulverized coal-fired, dry bottom boiler. The boiler was firing western Pennsylvania bituminous coal and was controlled by a wet limestone scrubber and ESP during the emissions test.

Three sampling runs were conducted for metals and organics, however, one of the metals runs was declared invalid because of a sample processing error. The emissions results are presented as emission factors in units of lb/10¹² Btu. Full detection limit values were used to develop emission factors that are based only on results that were below detection limits. The reference provides an average HHV for the coal fired during the emissions test of 13,733 Btu/lb on a dry basis and a coal moisture content of 4.12 percent. The dry-basis HHV was converted to an as-fired basis by dividing 13,733 Btu/lb by 104.12 percent, resulting in an HHV of 13,190 Btu/lb. The as-fired coal HHV was used to convert the emission factors in units of lb/10¹² Btu to factors in units of lb/ton.

This reference was assigned a data quality rating of "A."

Reference 21

This reference presents the results of emissions testing at a facility designated as EPRI Site 15. Site 15 has a boiler with a capacity of approximately 600 MW which began commercial operation in 1970. The boiler is a tangentially fired furnace manufactured by Combustion Engineering and was firing pulverized Eastern bituminous coal during the emissions test. The pollution control system in use during the test consisted of an ESP.

Three sampling runs were conducted for metals and organics and the results are presented as emission factors in units of $\text{lb}/10^{12}$ Btu. Full detection limit values were used to develop emission factors that are based only on results that were below detection limits. The reference provides an HHV for the coal fired during the test of 13,000 Btu/lb, which was assumed to be on an as-fired basis. This value was used to convert the emission factors in units of $\text{lb}/10^{12}$ Btu to factors in units of lb/ton.

A data quality rating of "A" was assigned to this reference.

Reference 22

The results of emissions testing at a facility designated as EPRI Site 19 are presented in this report. The boiler tested at Site 19 is a B & W opposed, wall-fired unit and was burning bituminous coal from western Virginia and Kentucky during the emissions test. An ESP was in use during the test.

Three sampling runs were conducted for various metals. The results for antimony, beryllium, and cobalt are presented as concentrations in units of microgram per Normal cubic meter. The results for the three compounds were above detection limits for all sampling runs. The concentrations were converted to lb/dscf and multiplied by the stack gas volumetric flow rate (dscf/hr) to obtain emission rates in units of lb/hr. The reference provides an average coal

feed rate during the test of 694,000 lb/hr on a dry-basis and a coal moisture content of 6.1 percent. The dry-basis coal feed rate was converted to an as-fired basis by dividing 694,000 by 93.9 percent (100 percent - 6.1 percent), resulting in a value of 739,084. The pollutant emission rates were divided by the coal feed rate to obtain emission factors in units of lb/ton.

The results for the other metals are expressed as emission factors in units of lb/10¹² Btu. The reference indicates that sampling results for all compounds were above the detection limits. The reference provides an average HHV of the coal fired during the test of 13,467 Btu/lb on a dry basis. This HHV was converted to an as-fired HHV of 12,693 Btu/lb by dividing 13,467 by 106.1 percent. The as-fired coal HHV was used to convert the emission factors in units of lb/10¹² Btu to factors in units of lb/ton.

This reference was assigned a data quality rating of "A."

Reference 23

This reference presents the results of emissions testing at a facility designated as EPRI Site 20. The boiler tested at Site 20 is a B & W wall-fired, drum type boiler with a normal full-load value of 680 MW. The boiler was firing pulverized lignite from Wilcox, Texas during the emissions test. Emission controls in use during the test include two parallel cold-side ESPs and a FGD system that uses limestone slurry for reagent.

Four sampling runs were conducted for various metals. The results for antimony are presented as concentrations in units of microgram per Normal cubic meter. Antimony was not detected in any of the sampling runs and the concentrations are based on full detection limits. The concentrations were converted to lb/dscf and multiplied by the stack gas volumetric flow rate (dscf/hr) to obtain emission rates in units of lb/hr. The reference provides a coal feed rate during the test of 618,000 lb/hr on a dry-basis and a coal moisture content of 34.4 percent.

The dry-basis coal feed rate was converted to an as-fired basis by dividing 618,000 by 66.4 percent (100 percent - 34.4 percent), resulting in a value of 942,073. The average antimony emission rate was divided by the coal feed rate to obtain an emission factor in units of lb/ton.

The results for the other metals are expressed as emission factors in units of lb/10¹² Btu. The reference indicates that all pollutants were detected in all sampling runs. The reference provides an HHV of the coal fired during the test of 6,760 Btu/lb on an as-received basis. This value was used to convert the emission factors in units of lb/10¹² Btu to factors in units of lb/ton.

This reference was assigned a data quality rating of "A."

Reference 24

The results of emissions testing at a facility designated as EPRI Site 21 are presented in this reference. The boiler at Site 21 is rated at 667 MW, gross load, and was firing bituminous coal from Pennsylvania and West Virginia during the emissions test. Emission controls utilized during the emissions test were a pilot ESP and FGD system. The FGD system is a spray tower absorber using an alkaline slurry. The pilot system has demonstrated the capability to produce the same results as a full-scale FGD system.

Eight sampling runs were conducted for metals and seven for PAHs. The results of the sampling runs are presented as emission factors in unit of lb/10¹² Btu. Full detection limit values were used to develop emission factors that are based only on sampling results that were below the detection limits. The reference presents an average HHV for the coal fired during the test of 14,032 Btu/lb on a dry basis and a coal moisture content of 7 percent. The dry-basis HHV was converted to an HHV on an as-fired basis by dividing 14,032 by

107 percent, resulting in a value of 13,114. The as-fired coal HHV was used to convert the emission factors in units of lb/10¹² Btu to factors in units of lb/ton.

A data quality rating of "A" was assigned to this reference.

Reference 25

This reference presents the results of emissions testing at a facility designated as EPRI Site 22. The boiler tested at Site 22 is a B & W 700 MW, wall-fired, radiant boiler. The boiler was burning pulverized subbituminous coal from the Powder River regions during the emissions test. Emission controls used during the test were two parallel cold-side ESPs.

Three sampling runs were conducted for metals, dioxins/furans, and polycyclic aromatic hydrocarbons (PAHs) and the results are presented as emission factors in units of lb/10¹² Btu. Full detection limit values were used to develop emission factors that are based only on results that were below the detection limits. The reference provides an average HHV for the coal fired during the emissions test of 11,981 Btu/lb on a dry-basis and a coal moisture content of 29.5 percent. The dry-basis HHV was converted to an as-fired HHV of 9,252 Btu/lb by dividing 11,981 by 129.5 percent. The as-fired coal HHV was used to convert the emission factors in units of lb/10¹² Btu to factors in units of lb/ton.

This report was assigned a data quality rating of "A."

Reference 26

This reference presents the results of emissions testing at a facility designated as EPRI Site 101. The boiler tested at this site is a B & W, 800 MW, wall-fired unit and was burning pulverized subbituminous coal from New Mexico during the emissions test. Emission controls

in use during the test include low NO_x burners, a fabric filter, and FGD system consisting of a wet lime scrubber.

Three sampling runs were conducted for metals and organics. The solid phase sample for metals test Run Two was destroyed prior to analysis and, therefore, except for mercury, the metals emissions results are based on two sampling runs. Because mercury is present primarily in the vapor phase, the solid phase average of Runs One and Three was used to represent the solid phase results for mercury for Run Two.

The test runs results are presented as emission factors in units of lb/10¹² Btu. The reference presents an average HHV for the coal fired during the test of 10,190 Btu/lb on a dry basis and a coal moisture content of 14 percent. The dry-basis HHV was converted to an as-fired HHV by dividing 10,190 by 114 percent, resulting in a value of 8,939. The as-fired coal HHV was used to convert the emission factors in units of lb/10¹² Btu to factors in units of lb/ton.

A data quality rating of "A" was assigned to this reference.

Reference 27

The results of emissions testing at a facility designated as EPRI Site 111 are presented in this reference. The boiler at this site is 267 MW, two-flow, single-reheat, balanced draft, drum type boiler. The boiler was burning a Western subbituminous coal during the tests. The pollution control system in use during the test consists of a fabric filter and spray dryers for FGD.

Two sampling runs were conducted for metals, PAHs, and various other organics. The results are expressed as emission factors in units of lb/10¹² Btu. Full detection limit values were used to develop emission factors that are based only on sampling results that were below

detection limits. The reference provides an average HHV for the coal fired during the test of 10,020 Btu/lb on an as-received basis. This value was used to convert the emission factors in units of lb/10¹² Btu to factors in units of lb/ton.

This report was assigned a data quality rating of "A."

Reference 28

This reference presents the results of emissions testing at a facility designated as Site 114. The unit at Site 114 is a B & W, cyclone-fired reheat boiler rated at 100 MW. Bituminous coal from Indiana was fired during the emissions tests. Emissions sampling was conducted under two boiler operating conditions, baseline and reburn. Emission controls used under the baseline operating condition consisted of an ESP. Controls used during the reburn operating condition were an ESP along with wall-fired burners located at a higher elevation in the boiler and overfire air to reduce NO_x emissions.

Three sampling runs for metals, PAHs, and various other organics were conducted under each operating condition and the results for each condition are reported separately and are expressed as emission factors in units of lb/10¹² Btu. PAHs are reported as "not detected" and no emission factors were developed. For the other "not detected" pollutants, full detection limit values were used to develop emission factors.

The reference reports an average HHV for the coal fired during the baseline condition of 13,490 Btu/lb on a dry-basis and a coal moisture content of 15.6 percent. The dry-basis HHV was converted to an as-fired basis by dividing 13,490 by 115.6 percent, resulting in an as-fired HHV of 11,670 Btu/lb. The reported average HHV for the coal fired during the reburn condition was 13,280 Btu/lb, dry-basis, and the average content was 12.5 percent. The dry-basis HHV was converted to an as-fired HHV by dividing 13,280 by 112.5 percent,

resulting in an as-fired HHV of 11,804 Btu/lb. The as-fired coal HHVs were used to convert the emission factors in units of lb/10¹² Btu to factors in units of lb/ton.

This reference was assigned a quality rating of "A."

Reference 29

The results of emissions testing at a facility designated as EPRI Site 115 are presented in this report. The unit tested at this site is a 117 MW B & W roof-fired boiler commissioned in 1955. The boiler was firing pulverized Western bituminous coal during the emissions tests. Emissions tests were conducted in two phases. Emission controls in use during both phases included low NO_x burners, overfire air, and a fabric filter. Additional controls used in Phase II included a urea injection system for selective non-catalytic NO_x reduction.

Three sampling runs were conducted for metals and organics during both operating conditions and the results are presented separately and are expressed as emission factors in lb/10¹² Btu. Full detection limit values were used to develop emission factors that are based only on sampling results that were below detection limits.

The report presents an average HHV for the coal of 12,565 Btu/lb and 12,638 Btu/lb fired during Phase I and Phase II, respectively. The reported HHV for the coal is on a dry basis and the reference does not provide the moisture content of the coal, as received. A test report the facility designated as EPRI Site 111 (Reference 27) where the boiler was firing a Western bituminous coal reports a moisture content of 9.8 percent. This value was used to convert the dry-basis coal HHV at Site 115 to an as-fired basis by dividing 12,565 and 12,638 by 109.8 percent, resulting in an as-fired HHV for the coal fired during Phase I testing of 11,444 Btu/lb and 11,510 Btu/lb for the coal fired during Phase II. The as-fired coal HHVs were used to convert the emission factors in units of lb/10¹² Btu to factors in units of lb/ton.

This reference was assigned a data quality rating of "C" because an as-fired coal HHV or information that could be used to calculate it were not provided.

Reference 30

This reference presents the results of DOE emissions testing at Springerville Generating Station Unit No. 2. This facility is owned and operated by the Tucson Electric Power Company and is located near Springerville, Arizona. Unit No. 2 was manufactured by Combustion Engineering and is a 397 MW, corner-fired, balanced-draft design. According to the EPRI Synthesis Report (Reference 9), this boiler is tangentially-fired. The unit was burning pulverized subbituminous coal from the Lee Ranch Mine in New Mexico during the emissions tests. Emission controls in use during the emissions test included overfire air and spray dryer absorbers.

Three sampling runs were conducted for metals and the results are expressed as ... emission factors in units of lb/10¹² Btu. Full detection limit values were used to develop emission factors that were not detected in any sampling run. The report presents an average as-received HHV for the coal fired during the emissions test of 9,446 Btu/lb. This value was used to convert the emission factors in units of lb/10¹² Btu to factors in units of lb/ton.

This reference was assigned a data quality rating of "A."

Reference 31

The results of DOE emissions testing at the Niles Station Unit No. 2 of Ohio Edison are presented in this reference. Unit No. 2 is a B & W, 108 MW, cyclone boiler and was burning pulverized bituminous coal during the emissions test. The coal is a blend of eastern Ohio and western Pennsylvania coals and is received in the respective proportions of 70/30. Emission controls in use during the test consisted of an ESP.

Three sampling runs were conducted for metals and various organics and the results are presented as emission factors expressed in units of $\text{lb}/10^{12}$ Btu. Emission factors for pollutants that were not detected in any sampling run were developed using one-half of the detection limit value. The average as-received HHV of the coal fired during the emissions test was 12,184 Btu/lb. This value was used to convert the emission factors in units of $\text{lb}/10^{12}$ Btu to factors in units of lb/ton.

This reference was assigned a data quality rating of "A."

Reference 32

This reference presents the results of DOE emissions testing at the Coal Creek Station which is operated by Cooperative Power and is located about 50 miles north of Bismarck, North Dakota. The unit tested is a 550 MW, tangentially-fired, water walled, dry bottom furnace, with a Combustion Engineering controlled circulation boiler. The furnace is fueled by lignite from the Falkirk mine located adjacent to the plant. Emission controls used during the test were an ESP and wet limestone scrubber.

Three sampling runs were conducted for metals and various organics and the results are presented as emission factors expressed in units of $\text{lb}/10^{12}$ Btu. Emission factors for pollutants that were not detected in any sampling run were developed using one-half of the detection limit value. The average as-received HHV for the lignite fired during the emissions test was 6,230 Btu/lb. This value was used to convert the emission factors in units of $\text{lb}/10^{12}$ Btu to factors in units of lb/ton.

This reference was assigned a data quality rating of "A."

Reference 33

The results of DOE emissions testing at Baldwin Power Station Unit 2 are presented in this reference. Unit 2, located in Baldwin, Illinois, is a B & W cyclone furnace rated at 568 MW and was built in 1973. The furnace was firing Illinois bituminous coal during the emissions test. Emission controls used during the test were an ESP.

Three sampling runs were conducted for metals and various organics, including PAHs and dioxins/furans. Test results are reported as emission factors expressed in units of lb/10¹² Btu. Full detection limit values were used to develop emission factors for pollutants that were not detected in any sampling run. The average of the HHV values reported in the reference for the coal fired during the emissions test was 10,633 Btu/lb, as received. The as-received coal HHV was used to convert the emission factors in units of lb/10¹² Btu to factors in units of lb/ton.

This reference was assigned a data quality rating of "A."

Reference 34

This reference presents the results of DOE emissions testing at the Boswell Energy Center Unit 2 located in Cohasset, Minnesota. This unit is a Riley Stoker front-fired boiler built in 1957 and rated at 69 MW. The boiler was burning pulverized western subbituminous coal from the Powder River Basin area of Wyoming and Montana during the emissions tests. Emission controls in use during the test were a baghouse.

Three sampling runs were conducted for metals and various organics, including PAHs and dioxins/furans. Emissions results are reported as emission factors expressed in units of lb/10¹² Btu. When a pollutant was not detected in any sampling run, full detection limit values were used to calculate an emission factor. The average of the HHV values reported in the reference for the coal fired during the emissions test was 8,798 Btu/lb, as received. This

value was used to convert the emission factors in units of lb/10¹² Btu to factors in units of lb/ton.

This reference was assigned a data quality rating of "A."

Reference 35

The results of DOE emissions testing at Cardinal Plant Unit 1 located in Brilliant, Ohio, are presented in this reference. Unit 1 is a wall-fired boiler rated at 615 MW and was burning pulverized Pittsburgh No. 8 bituminous coal during the emissions test. The unit is equipped with two ESPs arranged in parallel.

Three sampling runs for metals and various organics were conducted during sootblowing operations and three were conducted during non-sootblowing conditions. Emissions results are presented for both conditions, but only the results for non-sootblowing conditions were used to develop AP-42 emission factors. The emissions test results are reported as emission factors expressed in units of lb/10¹² Btu. For pollutants where the results for all sampling runs were below the detection limit, the average of the run detection limits was used to develop an emission factor. The reference does not report a coal feed rate or the HHV of the coal fired during the emissions test and, therefore, a value of 13,000 Btu/lb listed in Appendix A of AP-42 was used to convert the reported emission factors to emission factors in units of lb/ton.

A data quality rating of "C" was assigned to this reference because the coal feed rate and the coal HHV were not reported.

Reference 36

This reference presents the results of DOE emissions testing at a facility designated as Site 16. The unit tested is a Foster Wheeler wall-fired boiler rated at 500 MW. The EPRI Synthesis Report (Reference 9) indicates that the boiler was burning pulverized bituminous coal from Virginia and Kentucky during the emissions test. Emission controls in use during the test were low NO_x burners with overfire air and an ESP.

Three sampling runs were conducted for metals and various organics and the emissions results are presented as emission factors in units of lb/10¹² Btu. Full detection limit values were used to develop emission factors that are based only on results that were below the detection limit. The reference reports an average HHV for the coal fired during the emissions test of 13,800 Btu/lb, dry-basis, and a coal moisture content of 3.8 percent. The average dry-basis HHV was divided by 103.8 percent to obtain an average as-fired HHV of 13,295 Btu/lb. The as-fired coal HHV was used to convert the emission factors in units of lb/10¹² Btu to factors in units of lb/ton.

This reference was assigned a data quality rating of "A."

Reference 37

The results of emissions testing at a facility designated as EPRI Site 122 are presented in this reference. The unit tested is a cyclone boiler constructed during the 1950s and has a nominal power production capacity of 275 MW. The boiler was burning bituminous coal from the Illinois No. 5 Seam in Saline County, Illinois. An ESP was in use during the emissions test.

Three sampling runs were conducted for metals and organics and the emissions results are reported as emission factors that are expressed in units of lb/10¹² Btu. Full detection limit values were used to develop emission factors that are based only on results that were below the detection limit. The average HHV of the coal fired during the emissions test was

12,327 Btu/lb, as fired. This value was used to convert the emission factors in units of lb/10¹² Btu to factors in units of lb/ton.

This reference was assigned a data quality rating of "A."

Reference 38

This reference presents hydrogen chloride (HCl) and hydrogen fluoride (HF) emission factors that were developed from the results of a literature search. The literature search was conducted under the National Acid Precipitation Assessment Program (NAPAP).

The reference lists four emission factors each, or four pairs of factors, for HCl and HF. The factors are in units of lb/ton and represent both controlled and uncontrolled boilers. One pair of emission factors is for electric generation (utility) and industrial boilers firing bituminous or subbituminous coal. The second pair of factors is for utility and industrial boilers firing lignite. The third pair of emission factors is for commercial/institutional boilers firing bituminous or subbituminous coal. The fourth pair of factors is for commercial/institutional boilers firing lignite.

The reference states that AP-42 procedures for assigning quality ratings were used to assign ratings to the factors. The emission factor quality ratings were retained and it was not necessary to assign a data quality rating to this reference.

References Examined But Not Used For Emission Factor Development

Several documents were examined and the emissions data they contained were not used to develop emission factors because the data were not considered representative of the general population of coal or lignite-fired boilers. For example, data from boilers that were not burning 100 percent coal or lignite were excluded. Data from boilers that were not operating

normally or were using experimental control devices were not used. Also, data whose use would result in relatively low quality emission factors were not used. The following paragraphs describe the documents that were examined but not used and an explanation of why they were not used.

Results of the May 28 - 31, 1991 Trace Metal Characterization Study and Dioxin Emission Test on Unit 1 at the A.S. King Plant in Bayport, Minnesota. Interpoll Laboratories, Inc., Circle Pines, Minnesota. November 6, 1991. The boiler was firing a mixture of coal (90 percent) and petroleum coke (10 percent) at the time of the emissions tests.

Results of the July 1992 Air Toxic Emission Study on Unit 8 at the NSP Riverside Plant. Interpoll Laboratories, Inc., Circle Pines, Minnesota. September 29, 1992. The boiler was firing a mixture of coal (90 percent) and coke (6 percent) at the time of the emissions tests.

Measurement of Chemical Emissions Under the Influence of Low-NO_x Combustion Modifications. Submitted To Southern Company Services, Inc. Final Report. October 8, 1993. This facility was included in the emissions sampling program sponsored by EPRI and was designated Site 110. The reference states, "Site 110 provides control over the emissions of NO_x, however, it does so with modified combustion conditions having the potential of producing unwanted increases in the emissions of toxic organic compounds and conceivably undesirable changes in the emissions of inorganic substances."

A Study of Toxic Emissions From a Coal-fired Power Plant Utilizing an ESP While Demonstrating the ICCT CT-121 FGD Project. Radian Corporation, Austin, Texas. December 28, 1993. This facility was included in the emissions sampling program sponsored by EPRI and was designated DOE Site 4. The boiler was utilizing an experimental, or "demonstration," type of flue gas desulfurization technology during the emissions tests.

Preliminary Draft. Field Chemical Emissions Monitoring Project: Site 14 Emissions Monitoring. Radian Corporation, Austin, Texas. November 1992. This facility was included in the emissions sampling program sponsored by EPRI and was designated Site 14. The facility was utilizing a pilot-scale dry flue gas desulfurization system (FGD) at the time of the test. The pilot system consisted of a spray dryer followed by a pulse-jet fabric filter. A portion of the flue gas exiting the boiler was treated by the FGD system and then recombined with the gas entering the outlet stack.

Preliminary Draft. Field Chemical Emissions Monitoring Project: Site 18 Emissions Monitoring. Radian Corporation, Austin, Texas. April 1993. This facility was included in the emission sampling program sponsored by EPRI and was designated Site 18. At the time of the emissions test, the unit was not operating under optimal conditions. One of the five coal pulverizing mills was out of service and adjustments were made to the other four in order to maintain a steady operating load. Due to the adjustments, operating conditions for the unit were not normal. In addition, one of the control devices utilized by the boiler was experiencing problems and had to be repaired after the emissions test.

Field Chemical Emissions Monitoring Project: Site 116 Emissions Report. Radian Corporation, Austin, Texas. Preliminary Draft Report, October 1994. This facility was included in the emission sampling program sponsored by EPRI and was designated Site 116. The facility was utilizing a "demonstration" pollution control system at the time of the emissions tests. A portion of the flue gas was treated by the system and then rejoined with the flue gas exiting the boiler prior to entering another control device.

2.9.3 Emission Factor Development

Once the evaluation of all documents was completed and spreadsheets were created to contain the emissions information extracted from each reference, the emission factors from the individual spreadsheets were combined into groups of factors according to pollutant type. This

grouping was performed in order to more easily identify patterns in the emission factor values that could be attributed to coal type, boiler configuration (SCC), and/or control devices employed. Emission factors making up a pattern would be averaged together in order to develop an AP-42 emission factor that represents the boilers and emission controls included in the pattern. The groups are: (1) metals emission factor equations; (2) hydrogen chloride and hydrogen fluoride emission factors; (3) dioxin/furan emission factors; (4) metals emission factors; (5) PAH emission factors; and, (6) emission factors for various organics. A spreadsheet was constructed for each group of emission factors, except for the metals emission factor equations. These spreadsheets are hereafter referred to as "main" spreadsheets.

The metals emission factor equations were not revised or converted. Because no calculations were necessary, a main spreadsheet for the emission factor equations was not constructed. The main spreadsheet containing the HCl and HF emission factors has only four factors for each pollutant and no extensive data manipulation was necessary. The main spreadsheets for dioxins/furans, metals, PAHs, and organics contain factors from numerous sources, and some processing of the data was necessary in order to develop AP-42 emission factors. The following paragraphs describe how these data were processed.

Each main spreadsheet for dioxins/furans, metals, PAHs, and organics was constructed with all emission factors from a single reference arranged on one row, except in the case of multiple emission factors representing different operating conditions. In such cases, the factors for each operating condition were arranged on one row. In addition to the emission factors, other data obtained from the reference were included on the appropriate spreadsheet row. These data included the reference number, number of boilers tested, coal type, boiler type, boiler MW rating, boiler SCC, control devices used, reference data quality, and number of test runs. These data were included in order to document and characterize the emission factors. Each type of data was entered in a single column of the spreadsheet. For example, all SCCs are in a single column, all coal types are in a single column, all emission factors for arsenic are

in a single column, etc. With this arrangement, the data can be sorted by SCC, coal type, and control device in order to identify patterns in the emission factor values.

According to EPA guidance, emission factors that are based completely on detection limits should be calculated using one half of the detection limit. When the emission factors were extracted from the references, those factors based completely on detection limits were identified and it was noted if full value or one-half value detection limits were used to calculate them. All such factors were calculated using full detection limit values except for factors from Reference 31 and Reference 32, which were based on one-half detection limit values. All emission factors in the main spreadsheets that are based completely on detection limits were divided by two except for factors from Reference 31 and Reference 32. The factors from all references that are based completely on detection limits are identified by a "DL/2" in the column to the right of the emission factor.

EPA guidance also prescribes that when averaging emission factors together in order to obtain an AP-42 factor, the average should be an arithmetic mean. In addition, values representing factors based completely on detection limits that are larger than values representing factors that are based on detectable sample quantities (the pollutant was detected in at least one sampling run) should not be included in the overall averaging. In the main spreadsheets, after a group of emission factors for a pollutant were selected to be averaged together, the factors based only on detection limits were examined to determine if they should be included in the overall average. The "non-detected" factors that were higher in value than "detected" factors were not included in the overall average. In each column of pollutant emission factors, the factors (detected and non-detected) that are included in the overall average are marked with an asterisk in the column to the left of the factors. The average of the selected factors is at the bottom of the column. The quality rating of the average factor is included in the column to the right of the average factor.

When a pollutant was not detected at any facility, no AP-42 emission factor was developed for that pollutant. These pollutants appear in the main spreadsheets with a "DL/2" to the right of every factor for the pollutant. Although no emission factor was developed for these pollutants, they are identified in the footnotes of the AP-42 table that they would appear in if a factor had been developed.

The metals emission factor equations and the development of the HCl/HF emission factors are discussed below. The factors in the dioxin/furan, metals, PAHs, and organic main spreadsheets were sorted by SCC and control devices in order to identify patterns in the factor values that could be attributed to one or more of these parameters. The result of this sorting is also discussed below.

Metals Emission Factor Equations

The emission factor equations provided in Reference 9 are included in AP-42 "as is," (i.e., no conversions or revisions were made to the equations). There are equations for nine metals and they may be used to generate emission factors for both controlled and uncontrolled boilers. In addition, the equations may be used to generate emission factors for all typical firing configurations for utility, industrial, and commercial/industrial boilers. The emission factor equations are based on statistical correlations among measured trace element concentrations in coal, measured fractions of ash in coal, and measured particulate matter emission factors. Because these are the major parameters affecting trace metals emissions from coal combustion, it is recommended that the emission factor equations be used to generate emission factors when the inputs to the equations are available. If the inputs to the emission factor equations are not available for a pollutant and there is an emission factor for the provided in Section 1.7, then the factor should be used. The emission factor equations are provided in Table 1.

Hydrogen Chloride and Hydrogen Fluoride Emission Factors

All HCl and HF emission factors were obtained from Reference 38. These factors are shown in Table 2. The factors for utility/industrial boilers firing bituminous/subbituminous coal, commercial/industrial boilers firing bituminous/subbituminous coal, and commercial/industrial boilers firing lignite were averaged together to obtain an overall factor (one for HCl and one for HF) that represents all three categories. The emission factors for utility/industrial boilers firing lignite were not used in developing the AP-42 emission factors because of the relatively low value of the emission factors.

Dioxin/Furan, Metals, PAHs, and Various Organic Emission Factors

As described above, the emission factors for these pollutants were sorted by SCC and control device in order to identify patterns. No patterns became apparent in any of the four spreadsheets except in the spreadsheet containing the dioxin/furan emission factors. The emission factors for dioxins/furans are from bituminous and subbituminous coal only. None of the factors are from lignite combustion. For this reason, it was decided to include the dioxin/furan emission factors that were developed for AP-42 in Section 1.1 Bituminous and Subbituminous Coal Combustion but not in Section 1.7 Lignite Combustion. The factors for metals, PAHs, and organics are were averaged together to arrive at one AP-42 factor for each pollutant. The SCCs and controls attributed to the AP-42 factor are a combination of the SCCs and controls represented by the individual factors. These factors are included in both Section 1.1 and Section 1.7.

Copies of the spreadsheets used to develop the metals, PAHs, and various organic emission factors are shown in Tables 3, 4, and 5, respectively.

Table 1. METALS EMISSION FACTOR EQUATIONS FOR SECTION 1-7^{a,b}

| Pollutant | Emissions Equation^c (lb/10¹² Btu) |
|------------------|--|
| Antimony | $0.92 \times (C/A \times PM)^{0.63}$ |
| Arsenic | $3.1 \times (C/A \times PM)^{0.85}$ |
| Beryllium | $1.2 \times (C/A \times PM)^{1.1}$ |
| Cadmium | $3.3 \times (C/A \times PM)^{0.5}$ |
| Chromium | $3.7 \times (C/A \times PM)^{0.58}$ |
| Cobalt | $1.7 \times (C/A \times PM)^{0.69}$ |
| Lead | $3.4 \times (C/A \times PM)^{0.80}$ |
| Manganese | $3.8 \times (C/A \times PM)^{0.60}$ |
| Nickel | $4.4 \times (C/A \times PM)^{0.48}$ |

^a Reference 9.

^b All equations are rated "A." The emission factor equations are applicable to all typical firing configurations (SCCs) for electric generation (utility) boilers, industrial boilers, and commercial/industrial boilers firing bituminous coal, subbituminous coal, or lignite. Also, the equations apply to boilers using typical control devices, including no controls.

^c C = concentration of trace metal in the coal, parts per million by weight (ppm wt).
A = weight fraction of ash in coal, (dimensionless).
PM = site-specific emission factor for total particulate matter, (lb/10⁶ Btu).

Table 2. Data Used to Develop Hydrogen Chloride and Hydrogen Fluoride Emission Factors for Section 1.7 of AP-42^{a,b}

| Boiler SCC Descriptions | Source Classification Codes ^c | Hydrogen Chloride (lb/ton ^c) | Hydrogen Fluoride (lb/ton) |
|--|--|---|-------------------------------|
| Commercial/Industrial Boilers | | | |
| Bituminous and Subbituminous Coal Firing Types | | | |
| Pulverized Coal Wet Bottom | 1-03-002-05/21 | *1.48 | *0.17 |
| Pulverized Coal Dry Bottom | 1-03-002-06/22 | | |
| Overfeed Stoker | 1-03-002-07 | | |
| Underfeed Stoker | 1-03-002-08 | | |
| Spreader Stoker | 1-03-002-09/24 | | |
| Hand-fired | 1-03-002-14 | | |
| Pulverized Coal Dry Bottom Tangential | 1-03-002-16/26 | | |
| Atmospheric Fluidized Bed Combustor | 1-03-002-17/18 | | |
| Cyclone Furnace | 1-03-002-23 | | |
| Traveling Grate Overfeed Stoker | 1-03-002-25 | | |
| Electric Generation and Industrial Boilers | | | |
| Bituminous and Subbituminous Coal Firing Types | | | |
| Pulverized Coal Wet Bottom | 1-01-002-01/21 | *1.9 | *0.23 |
| | 1-02-002-01/21 | | |
| Pulverized Coal Dry Bottom | 1-01-002-02/22 | | |
| | 1-02-002-02/22 | | |
| Cyclone Furnace | 1-01-002-03/23 | | |

(continued)

**Table 2. Data Used to Develop Hydrogen Chloride and Hydrogen Fluoride
Emission Factors for Section 1.7 of AP-42 (Continued)^{a,b}**

| Boiler SCC Descriptions | Source Classification Codes ^c | Hydrogen Chloride (lb/ton ^c) | Hydrogen Fluoride (lb/ton) |
|-------------------------|--|---|-------------------------------|
| | 1-02-002-03/23 | | |

(continued)

Table 2. Data Used to Develop Hydrogen Chloride and Hydrogen Fluoride
Emission Factors for Section 1.7 of AP-42 (Continued)^{a,b}

| Boiler SCC Descriptions | Source Classification Codes ^c | Hydrogen Chloride (lb/ton ^c) | Hydrogen Fluoride (lb/ton) |
|---|--|---|-------------------------------|
| Spreader Stoker | 1-01-002-04/24 | | |
| | 1-02-002-04/24 | | |
| Traveling Grate Overfeed Stoker | 1-01-002-05/25 | | |
| | 1-02-002-25 | | |
| Overfeed Stoker | 1-02-002-05 | | |
| Pulverized Coal Dry Bottom, Tangential Firing | 1-01-002-12/26 | | |
| | 1-02-002-12 | | |
| Atmospheric Fluidized Bed | 1-01-002-17 | | |
| | 1-01-002-18 | | |
| | 1-02-002-17 | | |
| | 1-02-002-18 | | |
| Underfeed Stoker | 1-02-002-06 | | |
| Commercial/Industrial Boilers | | | |
| Lignite Firing Types | | | |
| Pulverized Coal | 1-03-003-05 | *0.351 | *0.063 |
| Pulverized Coal Tangential Firing | 1-03-003-06 | | |
| Traveling Grate Overfeed Stoker | 1-03-003-07 | | |
| Spreader Stoker | 1-03-003-09 | | |

(continued)

Table 2. Data Used to Develop Hydrogen Chloride and Hydrogen Fluoride Emission Factors for Section 1.7 of AP-42 (Continued)^{a,b}

| Boiler SCC Descriptions | Source Classification Codes ^c | Hydrogen Chloride (lb/ton ^c) | Hydrogen Fluoride (lb/ton) |
|--|--|--|----------------------------|
| Electric Generation and Industrial Boilers | | | |
| Lignite Firing Types | | | |
| Pulverized Coal | 1-01-003-01 | 0.01 | 0.01 |
| | 1-02-003-01 | | |
| Pulverized Coal Tangential Firing | 1-01-003-02 | | |
| | 1-02-003-02 | | |
| Cyclone Furnace | 1-01-003-03 | | |
| | 1-02-003-03 | | |
| Traveling Grate Overfeed Stoker | 1-01-003-04 | | |
| | 1-02-003-04 | | |
| Spreader Stoker | 1-01-003-06 | | |
| | 1-02-003-06 | | |
| | Overall Average | 1.2 | 0.15 |
| | Quality Rating | B | B |

^a All factors are from Reference 9.

^b Factors are for both uncontrolled and controlled boilers.

^c An asterisk to the left of a factor indicates that it was used in calculating the overall emission factor.

**TABLE 3. DATA USED TO DEVELOP CONTROLLED METALS
EMISSION FACTORS FOR SECTION 1.7 OF AP-42**

| Reference No. | No. of Boilers | Fuel Type | Boiler Type ^a | MW | SCC | Control Device 1 ^b | Control Device 2 ^b | Control Device 3 ^b | Data Quality | No. of Test Runs ^c | Antimony ^{c,d} | Arsenic ^{c,d} | Beryllium ^{c,d} | Cadmium ^{c,d} | Chromium ^{c,d} | Chromium VI ^{c,d} | Cobalt ^d |
|---------------|----------------|---------------|--------------------------|---------|----------|-------------------------------|-------------------------------|-------------------------------|--------------|-------------------------------|-------------------------|------------------------|--------------------------|------------------------|-------------------------|----------------------------|---------------------|
| 10 | 1 | Subbituminous | PC, DB | 860 | 10100222 | FGD-SDA | FF | none | A | 3 | --- | --- | --- | --- | --- | --- | --- |
| 10 | 2 | Subbituminous | PC, DB | 750 ea. | 10100222 | FGD-VSST | none | none | A | 3 | --- | --- | --- | --- | --- | --- | --- |
| 11 | 3 | Subbituminous | PC, DB | --- | 10100222 | ESP | ESP | none | B | 3 | 4.80e-05 DL/2 | *1.06e-05 | 1.16e-06 DL/2 | *5.31e-05 | *4.89e-05 | --- | --- |
| 12 | 1 | Subbituminous | AFBC, CB | 137 | 10100238 | Cyclone | ESP | ESP | B | 3 | 4.66e-06 DL/2 | *9.03e-06 | 2.33e-07 DL/2 | *1.11e-04 | *1.08e-04 | --- | --- |
| 13 | 4 | Subbituminous | PC, DB | --- | 10100222 | ESPC | none | none | B | 3 | *1.23e-05 | *5.63e-06 | *1.33e-06 | *1.11e-05 | *1.18e-04 | --- | --- |
| 14 | 2 | Subbituminous | PC, DB | --- | 10100222 | FF | none | none | B | 3 | *5.78e-06 | *1.89e-05 | *8.09e-06 | *4.83e-04 | *2.35e-04 | --- | --- |
| 15 | 2 | Subbituminous | PC, DB | 750 ea. | 10100222 | FGD-VSST | none | none | B | 3 | *9.12e-06 | *4.42e-05 | *4.34e-06 | *1.80e-05 | *1.95e-04 | --- | --- |
| 16 | 2 | Subbituminous | PC, DB | 750 ea. | 10100222 | FGD-VSST | none | none | B | 3 | *1.48e-05 | *4.26e-05 | *4.80e-06 | *4.78e-05 | *1.34e-04 | --- | --- |
| 17 | 1 | Subbituminous | PC, DB | 860 | 10100222 | FGD-SDA | FF | none | B | 3 | *7.06e-06 | *4.14e-07 DL/2 | *1.11e-07 | --- | *1.59e-04 | *1.49e-05 | --- |
| 18 | 1 | Subbituminous | AFBC, CB | 110 | 10100238 | FGD-FIL | FF | none | A | 1 | --- | 1.03e-05 DL/2 | 2.05e-06 DL/2 | 4.10e-06 DL/2 | *3.28e-05 | --- | 8.20e-06 DL/2 |
| 19 | 1 | Subbituminous | PC, DB, T | 700 | 10100226 | OFA | FGD-WLS | ESP | B | 1 | --- | *1.41e-05 | 1.41e-06 DL/2 | *1.83e-05 | *9.87e-05 | --- | *2.40e-05 |
| 20 | 1 | Bituminous | PC, DB, O | 700 | 10100202 | ESP | FGD-WLS | none | A | 2 | --- | *1.19e-05 | 2.11e-06 DL/2 | *3.17e-05 | *9.23e-05 | --- | 1.32e-05 DL/2 |
| 21 | 1 | Bituminous | PC, DB, T | 600 | 10100212 | ESP | none | none | A | 3 | --- | *3.38e-04 | *1.04e-05 | *8.06e-05 | *3.12e-04 | --- | *5.20e-05 |

(continued)

**Table 3. Data Used to Develop Controlled Metals Emission Factors
for Section 1.7 of AP-42 (Continued)^{a,b}**

| Reference No. | No. of Boilers | Fuel Type | Boiler Type ^a | MW | SCC | Control Device 1 ^b | Control Device 2 ^b | Control Device 3 ^b | Data Quality | No. of Test Runs ^c | Antimony ^{c,d} | Arsenic ^{c,d} | Beryllium ^{c,d} | Cadmium ^{c,d} | Chromium ^{c,d} | Chromium VI ^{c,d} | Cobalt ^d |
|---------------|----------------|---------------|--------------------------|-------|----------|-------------------------------|-------------------------------|-------------------------------|--------------|-------------------------------|-------------------------|------------------------|--------------------------|------------------------|-------------------------|----------------------------|---------------------|
| 22 | 1 | Bituminous | PC, DB, O | 1,160 | 10100202 | ESP | none | none | A | 3 | *3.83e-05 | *2.01e-04 | *3.08e-05 | *3.30e-06 | *3.30e-04 | --- | *1.32e-04 |
| 23 | 1 | Lignite | PC | 680 | 10100301 | ESP | FGD-W LS | none | A | 4 | 8.70e-06 DL/2 | *8.52e-06 | *4.73e-06 | *9.46e-06 | *3.79e-05 | --- | *9.33e-06 |
| 24 | 1 | Bituminous | PC, DB, O | 667 | 10100202 | ESP | FGD-W LS | none | A | 8 | --- | *1.62e-04 | *3.41e-06 | *1.49e-05 | *7.19e-05 | --- | *1.08e-04 |
| 25 | 1 | Subbituminous | PC, DB, O | 700 | 10100222 | ESP | none | none | A | 3 | 3.52e-05 DL/2 | *1.61e-06 | 2.87e-07 DL/2 | *2.96e-06 | *9.81e-06 | --- | 6.50e-06 DL/2 |
| 26 | 1 | Subbituminous | PC, DB, W | 800 | 10100222 | LNB | FF | FGD-W LS | A | 2 | --- | *6.08e-06 | *6.44e-07 | *7.15e-06 | *3.93e-05 | --- | *2.32e-06 |
| 27 | 1 | Subbituminous | PC, DB | 267 | 10100222 | LNB | FGD-SD | FF | A | 2 | --- | 2.11e-06 DL/2 | --- | 2.11e-05 DL/2 | 4.31e-05 DL/2 | --- | --- |
| 28 | 1 | Bituminous | Cy-clone | 100 | 10100203 | ESP | none | none | A | 3 | --- | *1.63e-04 | *5.60e-05 | *4.20e-05 | *3.27e-04 | --- | --- |
| 28 | 1 | Bituminous | Cy-clone | 100 | 10100203 | Reburn/ OFA | ESP | none | A | 3 | --- | *1.89e-04 | *1.89e-05 | *9.44e-06 | *1.09e-04 | --- | --- |
| 29 | 1 | Bituminous | PC, DB | 117 | 10100202 | LNB/ OFA | FF | none | B | 3 | --- | *1.72e-05 | 2.29e-07 DL/2 | *2.75e-06 | *1.51e-05 | --- | 2.52e-06 DL/2 |
| 29 | 1 | Bituminous | PC, DB | 117 | 10100202 | LNB/ OFA | SNCR | FF | B | 3 | --- | *3.45e-06 | 2.30e-07 DL/2 | *8.05e-07 DL/2 | *6.91e-06 | --- | 2.65e-06 DL/2 |
| 30 | 1 | Subbituminous | PC, DB, T | 422 | 10100226 | LNB/ OFA | FGD-SD A | FF | A | 3 | *7.75e-07 | *2.83e-06 | 3.78e-07 DL/2 | *4.91e-07 | *1.89e-06 | --- | 2.84e-06 DL/2 |
| 31 | 1 | Bituminous | Cy-clone | 108 | 10100203 | ESP | none | none | A | 3 | 4.39e-06 DL/2 | *1.02e-03 | *4.63e-06 | *1.71e-06 | *7.31e-05 | --- | *1.46e-06 DL/2 |

(continued)

**Table 3. Data Used to Develop Controlled Metals Emission Factors
for Section 1.7 of AP-42 (Continued)^{a,b}**

| Reference No. | No. of Boilers | Fuel Type | Boiler Type ^a | MW | SCC | Control Device 1 ^b | Control Device 2 ^b | Control Device 3 ^b | Data Quality | No. of Test Runs ^c | Antimony ^{c,d} | Arsenic ^{c,d} | Beryllium ^{c,d} | Cadmium ^{c,d} | Chromium ^{c,d} | Chromium VI ^{c,d} | Cobalt ^d |
|----------------|----------------|---------------|--------------------------|-----|----------|-------------------------------|-------------------------------|-------------------------------|--------------|-------------------------------|-------------------------|------------------------|--------------------------|------------------------|-------------------------|----------------------------|---------------------|
| 32 | 1 | Lignite | PC, DB, T | 550 | 10100302 | ESP | FGD-WLS | none | A | 3 | *2.24e-06 | *1.50e-05 | 1.06e-05 DL/2 | 1.99e-05 DL/2 | --- | --- | *1.87e-05 |
| 33 | 1 | Bituminous | Cy-clone | 568 | 10100203 | ESP | none | none | A | 3 | *3.23e-05 | *2.85e-04 | *3.00e-05 | *6.42e-05 | *1.08e-03 | --- | *1.45e-04 |
| 34 | 1 | Subbituminous | PC, DB | 69 | 10100222 | FF | none | none | A | 3 | 5.95e-06 DL/2 | *5.70e-06 | 1.14e-06 DL/2 | 5.70e-06 DL/2 | *3.59e-05 | --- | *1.23e-05 |
| 35 | 1 | Bituminous | PC, DB | 615 | 10100202 | ESP | none | none | C | 3 | *6.14e-05 | *9.07e-05 | *1.82e-06 | *2.20e-05 | *1.95e-04 | --- | *1.64e-05 |
| 36 | 1 | Bituminous | PC, DB | 500 | 10100202 | LNB/OFA | ESP | none | A | 3 | --- | *2.92e-03 | *8.24e-05 | *9.57e-05 | *5.58e-04 | *1.44e-04 | *1.73e-04 |
| 37 | 1 | Bituminous | Cy-clone | 275 | 10100203 | ESP | none | none | A | 3 | --- | *5.42e-03 | *9.86e-05 | *8.88e-05 | *2.47e-03 | --- | *6.41e-04 |
| Average Factor | | | | | | | | | | | 1.84e-05 | 4.08e-04 | 2.12e-05 | 5.08e-05 | 2.55e-04 | 7.95e-05 | 1.03e-04 |
| Quality Rating | | | | | | | | | | | A | A | A | A | A | D | A |

^a PC = Pulverized Coal, DB = Dry Bottom, T = Tangential, O = Opposed, W = Wall, AFBC = Atmospheric Fluidized Bed Combustor, CB = Circulating Bed.

^b ESP = Electrostatic Precipitator, FGD = Flue Gas Desulfurization, FIL = Furnace Injection of Limestone, FF = Fabric Filter, LNB = Low Nox Burners, OFA = Overfire Air, SDA = Spray Dryer Absorber, SNCR = Selective Non-catalytic Reduction, WLS = Wet Limestone Scrubber, VSST = Venturi Scrubber Spray Tower. These are the controls that were in place during the emissions tests.

^c An asterisk before a factor indicates that the factor was used in calculating the overall average.

^d A "DL/2" after a number indicates that the pollutant was not detected in any of the sampling runs used to develop the factor. The value shown here represents a factor based on one half of the detection limit.

Table 4. Data Used to Develop Controlled PAH Emission Factors for Section 1.7 of AP-42

| Ref. No. | No. of Boilers | Type of Coal | Boiler Type | MW | SCC | Control Device 1 ^a | Control Device 2 ^b | Control Device 3 ^b | Data Quality | No. of Test Runs ^c | Biphenyl ^d | Acenaphthene ^{c,d} | Acenaphthylene ^{c,d} | Anthracene ^{c,d} | Benz(a)-anthracene ^{c,d} | Benzo(a)-pyrene ^{c,d} | Benzo(b,j,k)-fluoranthene ^d |
|----------------|----------------|---------------|-------------|-----|----------|-------------------------------|-------------------------------|-------------------------------|--------------|-------------------------------|-----------------------|-----------------------------|-------------------------------|---------------------------|-----------------------------------|--------------------------------|--|
| 29 | 1 | Subbituminous | PC,DB,T | 700 | 10100226 | OFA | FGD-WLS | ESP | B | 1 | --- | --- | --- | --- | --- | --- | --- |
| 34 | 1 | Bituminous | PC,DB,O | 667 | 10100202 | ESP | FGD-WLS | none | A | 7 | --- | *4.72e-07 | *1.97e-07 | *2.60e-07 | *3.41e-08 | *4.72e-08 | *1.73e-07 |
| 35 | 1 | Subbituminous | PC,DB,O | 700 | 10100222 | ESP | none | none | A | 3 | --- | *1.11e-07 | *6.29e-08 | *8.51e-08 | *1.85e-08 | *2.04e-08 | *5.00e-08 |
| 37 | 1 | Subbituminous | PC,DB | 267 | 10100222 | LNB | FGD-SD | FF | A | 2 | --- | *1.60e-06 | *6.01e-07 | *4.01e-07 | *1.80e-07 | 4.01e-08 DL/2 | *2.40e-07 |
| 39 | 1 | Bituminous | PC,DB | 117 | 10100202 | LNB/OFA | FF | none | B | 3 | --- | --- | --- | --- | --- | --- | --- |
| 41 | 1 | Bituminous | Cyclone | 108 | 10100203 | ESP | none | none | A | 3 | *3.06e-06 | *6.46e-07 | *1.66e-07 | *5.04e-07 | *9.02e-08 | 2.92e-08 DL/2 | *1.71e-07 |
| 42 | 1 | Lignite | PC,DB,T | 550 | 10100302 | ESP | FGD-WLS | none | A | 3 | *2.87e-07 | *2.16e-07 | *1.31e-07 | *1.83e-07 | *2.62e-08 | *1.12e-08 | *5.61e-08 |
| 43 | 1 | Bituminous | Cyclone | 568 | 10100203 | ESP | none | none | A | 3 | 9.35e-06 DL/2 | *6.70e-08 DL/2 | *6.78e-07 | *5.61e-08 | *2.49e-08 | 5.80e-09 DL/2 | *8.32e-08 |
| 44 | 1 | Subbituminous | PC,DB | 69 | 10100222 | FF | none | none | A | 3 | 1.57e-06 DL/2 | *7.18e-07 | *9.34e-08 | *1.09e-07 | *8.23e-08 | *3.68e-09 | *5.37e-08 |
| 45 | 1 | Bituminous | PC,DB | 615 | 10100202 | ESP | none | none | C | 3 | --- | --- | --- | --- | --- | --- | --- |
| 46 | 1 | Bituminous | PC,DB | 500 | 10100202 | LNB/OFA | ESP | none | A | 3 | --- | *2.15e-07 | *7.98e-08 | *9.84e-08 | *1.86e-07 | *1.09e-07 | *3.99e-08 |
| Average Factor | | | | | | | | | | | 1.67e-06 | 5.06e-07 | 2.51e-07 | 2.12e-07 | 8.03e-08 | 3.83e-08 | 1.08e-07 |
| Quality Rating | | | | | | | | | | | D | B | B | B | B | D | B |

^a PC = Pulverized Coal, DB = Dry Bottom, T = Tangential, O = Opposed.

^b ESP = Electrostatic Precipitator, FF = Fabric Filter, FGD = Flue Gas Desulfurization, LNB = Low Nox Burners, OFA = Overfire Air, SD = Spray Dryer, WLS = Wet Limestone Scrubber. These controls were in use during emissions tests.

^c An asterisk before a factor indicates that the factor was used in calculating the overall average.

^d A "DL/2" after a number indicates that the pollutant was not detected in any of the sampling runs used to develop the factor. The value shown here represents a factor based on one half of the detection limit.

Table 5. Data Used to Develop Organic Emission Factors for Section 1.7 of AP-42

| Reference No. | No. of Boilers | Coal Type | Boiler Type ^a | MW | SCC | Control Device 1 ^b | Control Device 2 ^b | Control Device 3 ^b | Data Quality | No. of Test Runs ^c | Acetaldehyde ^{c,d} | Acetophenone ^{c,d} | Acrolein ^{c,d} | Benzene ^{c,d} | Benzylchloride ^{c,d} | his(2-ethyl-hexyl-phthalate) ^{c,d} | Bromo-form ^d |
|---------------|----------------|---------------|--------------------------|-----|----------|-------------------------------|-------------------------------|-------------------------------|--------------|-------------------------------|-----------------------------|-----------------------------|-------------------------|------------------------|-------------------------------|---|-------------------------|
| 23 | 4 | Subbituminous | PC,DB | --- | 10100222 | ESP | none | none | B | 3 | --- | --- | --- | *5.45e-07 DL/2 | --- | --- | --- |
| 24 | 1 | Subbituminous | PC,DB | --- | 10100222 | FF | none | none | B | 3 | --- | --- | --- | *1.66e-02 | --- | --- | --- |
| 24 | 1 | Subbituminous | PC,DB | --- | 10100222 | FF | none | none | B | 3 | --- | --- | --- | 6.30e-04 DL/2 | --- | --- | --- |
| 28 | 1 | Subbituminous | AFBC,CB | 110 | 10100238 | FGD-FIL | FF | none | A | 1 | --- | --- | --- | *4.10e-05 | --- | *9.24e-05 | --- |
| 29 | 1 | Subbituminous | PC,DB,T | 700 | 10100226 | OFA | FGD-WLS | ESP | B | 1 | --- | --- | --- | --- | --- | --- | --- |
| 30 | 1 | Bituminous | PC,DB,O | 700 | 10100202 | ESP | FGD-WLS | none | A | 2 | --- | --- | --- | *1.82e-05 | --- | --- | --- |
| 31 | 1 | Bituminous | PC,DB,T | 600 | 10100212 | ESP | none | none | A | 3 | --- | --- | --- | *2.08e-05 | --- | --- | --- |
| 34 | 1 | Bituminous | PC,DB,O | 667 | 10100202 | ESP | FGD-WLS | none | A | 7 | --- | --- | --- | --- | --- | --- | --- |
| 35 | 1 | Subbituminous | PC,DB,O | 700 | 10100222 | ESP | none | none | A | 3 | --- | --- | --- | --- | --- | --- | --- |
| 36 | 1 | Subbituminous | PC,DB,W | 800 | 10100222 | LNB | FF | FGD-WLS | A | 2 | --- | --- | --- | *1.02e-05 | --- | --- | --- |
| 37 | 1 | Subbituminous | PC,DB | 267 | 10100222 | LNB | FGD-SD | FF | A | 2 | --- | --- | --- | *4.23e-04 | --- | --- | --- |
| 38 | 1 | Bituminous | Cyclone | 100 | 10100203 | ESP | none | none | A | 3 | *6.07e-05 | --- | --- | *5.37e-05 | --- | --- | --- |
| 38 | 1 | Bituminous | Cyclone | 100 | 10100203 | Reburn/OFA | ESP | none | A | 3 | *3.07e-05 DL/2 | --- | --- | *2.46e-05 | --- | --- | --- |
| 39 | 1 | Bituminous | PC,DB | 117 | 10100202 | LNB/OFA | FF | none | B | 3 | --- | --- | --- | *5.95e-05 | --- | --- | --- |
| 41 | 1 | Bituminous | Cyclone | 108 | 10100203 | ESP | none | none | A | 3 | *2.17e-03 | *1.55e-05 | *9.99e-04 | *1.93e-04 | 1.44e-07 DL/2 | --- | 5.85e-05 |
| 42 | 1 | Lignite | PC,DB,T | 550 | 10100302 | ESP | FGD-WLS | none | A | 3 | *8.35e-04 | *6.76e-06 | *1.37e-05 DL/2 | *5.11e-04 | *7.10e-08 | --- | *3.86e-05 |
| 43 | 1 | Bituminous | Cyclone | 568 | 10100203 | ESP | none | none | A | 3 | *2.91e-04 | *2.62e-05 | *7.55e-05 | *2.57e-03 | --- | *9.78e-05 | --- |
| 44 | 1 | Subbituminous | PC,DB | 69 | 10100222 | FF | none | none | A | 3 | *9.60e-06 DL/2 | *1.25e-05 | *5.98e-05 | *1.81e-03 | --- | *2.96e-05 | --- |
| 45 | 1 | Bituminous | PC,DB | 615 | 10100202 | ESP | none | none | C | 3 | --- | --- | --- | *8.84e-05 | *1.40e-03 | --- | --- |

(continued)

Table 5. Data Used to Develop Organic Emission Factors for Section 1.7 of AP-42 (Continued)

| Reference No. | No. of Boilers | Coal Type | Boiler Type ^a | MW | SCC | Control Device 1 ^b | Control Device 2 ^b | Control Device 3 ^b | Data Quality | No. of Test Runs ^c | Acetaldehyde ^{c,d} | Acetophenone ^{c,d} | Acrolein ^{c,d} | Benzene ^{c,d} | Benzylchloride ^{c,d} | bis(2-ethyl-hexyl-phthalate) ^{c,d} | Bromo-form ^d |
|----------------|----------------|------------|--------------------------|-----|----------|-------------------------------|-------------------------------|-------------------------------|--------------|-------------------------------|-----------------------------|-----------------------------|-------------------------|------------------------|-------------------------------|---|-------------------------|
| 46 | 1 | Bituminous | PC,DB | 500 | 10100202 | LNB/OF A | ESP | none | A | 3 | --- | --- | --- | *1.36e-05 | --- | --- | --- |
| 47 | 1 | Bituminous | Cyclone | 275 | 10100203 | ESP | none | none | A | 3 | --- | --- | --- | *1.92e-04 | --- | --- | --- |
| Average Factor | | | | | | | | | | | 5.66e-04 | 1.52e-05 | 2.87e-04 | 1.33e-03 | 7.00e-04 | 7.33e-05 | 3.86e-05 |
| Quality Rating | | | | | | | | | | | C | D | D | A | D | D | E |

^a PC = Pulverized Coal, DB = Dry Bottom, AFBC = Atmospheric Fluidized Bed Combustion, CB = Circulating Bed, T = Tangential, O = Opposed, W = Wall.
^b Controls in use during emissions tests: ESP = Electrostatic Precipitator, FF = Fabric Filter, FGD = Flue Gas Desulfurization, FIL = Furnace Injection of Limestone, LNB = Low Nox Burners, SD = Spray Dryer, WLS = Wet Limestone Scrubber.
^c An asterisk before a factor indicates that it was used in calculating the overall emission factor.
^d A DL/2 after a factor indicates that the pollutant was not detected in any of the sampling runs used to develop the factor. The value shown here represents a factor based on one half the detection limit.

Table 5. Data Used to Develop Organic Emission Factors for Section 1.7 of AP-42 (Continued)

| Reference No. | No. of Boilers | Coal Type | Boiler Type ^a | MW | SCC | Control Device 1 ^b | Control Device 2 ^b | Control Device 3 ^b | Data Quality | No. of Test Runs ^c | Acetaldehyde ^{c,d} | Acetophenone ^{c,d} | Acrolein ^{c,d} | Benzene ^{c,d} | Benzylchloride ^{c,d} | bis(2-ethyl-hexyl-phthalate) ^{c,d} | Bromo-form ^d |
|----------------|----------------|------------|--------------------------|-----|----------|-------------------------------|-------------------------------|-------------------------------|--------------|-------------------------------|-----------------------------|-----------------------------|-------------------------|------------------------|-------------------------------|---|-------------------------|
| 46 | 1 | Bituminous | PC,DB | 500 | 10100202 | LNB/OF A | ESP | none | A | 3 | --- | --- | --- | *1.36e-05 | --- | --- | --- |
| 47 | 1 | Bituminous | Cyclone | 275 | 10100203 | ESP | none | none | A | 3 | --- | --- | --- | *1.92e-04 | --- | --- | --- |
| Average Factor | | | | | | | | | | | 5.66e-04 | 1.52e-05 | 2.87e-04 | 1.33e-03 | 7.00e-04 | 7.33e-05 | 3.86e-05 |
| Quality Rating | | | | | | | | | | | C | D | D | A | D | D | E |

^a PC = Pulverized Coal, DB = Dry Bottom, AFBC = Atmospheric Fluidized Bed Combustion, CB = Circulating Bed, T = Tangential, O = Opposed, W = Wall.

^b Controls in use during emissions tests: ESP = Electrostatic Precipitator, FF = Fabric Filter, FGD = Flue Gas Desulfurization, FIL = Furnace Injection of Limestone, LNB = Low Nox Burners, SD = Spray Dryer, WLS = Wet Limestone Scrubber.

^c An asterisk before a factor indicates that it was used in calculating the overall emission factor.

^d A DL/2 after a factor indicates that the pollutant was not detected in any of the sampling runs used to develop the factor. The value shown here represents a factor based on one half the detection limit.

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4.0 REVISED SECTION 1.7

This section contains the revised Section 1.7 of AP-42, 5th Edition. The electronic version can be located on the EPA TTN at <http://134.67.104.12/html/chief/fsnpub.htm>.

5.0 EMISSION FACTOR DOCUMENT, APRIL 1993

This section contains the complete Emission Factor Document for Section 1.7, Lignite Combustion, dated April 1993. The electronic version can be located on the EPA TTN at <http://134.67.104.12/html/chief/fbgdocs.htm>. The zipped file on the TTN contains this (1996) background report as well as the 1993 Emission Factor Documentation.

Appendix A

REFERENCE 19 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: RESULTS OF THE MARCH 28, 1990 DIOXIN EMISSION
PERFORMANCE TEST ON UNIT 3 AT THE NSP SHERCO
PLANT IN BECKER, MINNESOTA

FACILITY: NSP SHERCO
UNIT NO.: 3
LOCATION: Becker, Minnesota
FILENAME SHERCO3.tbl

| PROCESS DATA | | | |
|---|---|-------------|-------------|
| | Run 1 | Run 2 | Run 3 |
| Oxygen (% v/v) ^a | 6.30 | 5.80 | 5.80 |
| Vol. Flow Rate (dscf/m) ^b | 1,971,603 | 1,939,776 | 1,952,851 |
| Vol. Flow Rate (dscf/hr) | 118,296,180 | 116,386,560 | 117,171,060 |
| F-factor (dscf/MMBtu) ^c | 9,780 | 9,780 | 9,780 |
| Heat input (MMBtu/hr) | 8,450 | 8,598 | 8,656 |
| HHV Bituminous Coal (Btu/lb) ^d | 8,547 | 8,547 | 8,547 |
| HHV Bituminous Coal (Btu/ton) | 17,094,000 | 17,094,000 | 17,094,000 |
| Coal Feed (ton/hr) | 494 | 503 | 506 |
| Coal type ^e | Subbituminous | | |
| Boiler configuration ^e | Pulverized, dry bottom | | |
| Coal source ^e | Montana | | |
| SCC | 10100222 | | |
| Control device 1 ^e | Flue Gas Desulfurization, Spray Dryer absorber | | |
| Control device 2 ^e | Baghouse | | |
| Data Quality | C- Coal heating value and feed rate not provided. | | |
| Process Parameters ^e | 860 megawatts, on line in 1987. | | |
| Test methods ^f | MM5 | | |
| Number of test runs ^g | 3 | | |

REFERENCE 19 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION

^aPage 8.

^bPage 9.

^c40 CFR Pt 60, Appendix A, Meth. 19, Bituminous coal

^dFrom report "Results of the May 29, 1990 Trace Metal Characterization Study on Units 1 and 2 at the Sherburne County Generating Station in Becker, Minnesota", page G-1. (Reference No. 25).

^ePage 1. Assumed dry bottom.

^fPage 1.

^gPage 5.

REFERENCE 19 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION

| DIOXIN/FURAN EMISSION FACTORS | | | | |
|-------------------------------------|-----------|----------|----------|-----|
| EMISSION RATES (g/sec) ^a | | | | |
| | Run 1 | Run 2 | Run 3 | AVG |
| TCDD | 4.0e-08 | 2.0e-08 | 1.4e-08 | |
| PeCDD | 7.8e-08 | 3.8e-08 | 1.7e-08 | |
| HxCDD | 3.2e-07 | 1.6e-07 | 8.6e-08 | |
| HpCDD | 1.19e-06 | 4.6e-07 | 2.4e-07 | |
| OCDD | 3.51e-06 | 1.16e-06 | 7.2e-07 | |
| TCDF | 3.2e-07 | 1.0e-07 | 4.8e-08 | |
| PeCDF | 5.7e-07 | 2.2e-07 | 1.2e-07 | |
| HxCDF | 1.43e-06 | 6.5e-07 | 3.2e-07 | |
| HpCDF | 5.12e-06 | 1.97e-06 | 1.18e-06 | |
| OCDF | 1.670e-05 | 5.12e-06 | 4.02e-06 | |
| EMISSION RATES (lb/hr) ^b | | | | |
| | Run 1 | Run 2 | Run 3 | AVG |
| TCDD | 3.18e-07 | 1.59e-07 | 1.11e-07 | |
| PeCDD | 6.19e-07 | 3.02e-07 | 1.35e-07 | |
| HxCDD | 2.54e-06 | 1.27e-06 | 6.83e-07 | |
| HpCDD | 9.45e-06 | 3.65e-06 | 1.91e-06 | |
| OCDD | 2.79e-05 | 9.21e-06 | 5.72e-06 | |
| TCDF | 2.54e-06 | 7.94e-07 | 3.81e-07 | |
| PeCDF | 4.52e-06 | 1.75e-06 | 9.53e-07 | |
| HxCDF | 1.14e-05 | 5.16e-06 | 2.54e-06 | |
| HpCDF | 4.06e-05 | 1.56e-05 | 9.37e-06 | |
| OCDF | 1.33e-04 | 4.06e-05 | 3.19e-05 | |

REFERENCE 19 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION

| EMISSION FACTORS (lb/ton) ^c | Run 1 | Run 2 | Run 3 | AVG |
|---|----------|----------|----------|----------|
| TCDD | 6.42e-10 | 3.16e-10 | 2.19e-10 | 3.93e-10 |
| PeCDD | 1.25e-09 | 6.00e-10 | 2.67e-10 | 7.06e-10 |
| HxCDD | 5.14e-09 | 2.53e-09 | 1.35e-09 | 3.00e-09 |
| HpCDD | 1.91e-08 | 7.26e-09 | 3.76e-09 | 1.00e-08 |
| OCDD | 5.64e-08 | 1.83e-08 | 1.13e-08 | 2.87e-08 |
| TCDF | 5.14e-09 | 1.58e-09 | 7.52e-10 | 2.49e-09 |
| PeCDF | 9.15e-09 | 3.47e-09 | 1.88e-09 | 4.84e-09 |
| HxCDF | 2.30e-08 | 1.03e-08 | 5.02e-09 | 1.27e-08 |
| HpCDF | 8.22e-08 | 3.11e-08 | 1.85e-08 | 4.39e-08 |
| OCDF | 2.68e-07 | 8.08e-08 | 6.30e-08 | 1.37e-07 |
| ^a Page 4 ^b Convert g/sec to lb/hr. ^c Divide emission rate by coal feed rate. | | | | |

REFERENCE 20 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 10 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: RESULTS OF THE SEPTEMBER 10 AND 11, 1991 MERCURY
REMOVAL TESTS ON THE UNITS 1 & 2, AND UNIT 3
SCRUBBER SYSTEMS AT THE NSP SHERCO PLANT IN
BECKER, MINNESOTA

FACILITY: NSP SHERCO
UNIT NO.: 3
LOCATION: Becker, Minnesota
FILENAME: SHRCO123.tbl

FILENAME: SHRC0125.101

| PROCESS DATA UNIT 3 | | | |
|--------------------------------------|--|-------------|-------------|
| | Run 1 | Run 2 | Run 3 |
| Vol. Flow Rate (dscf/m) ^a | 1,909,745 | 1,908,275 | 1,850,934 |
| Vol. Flow Rate (dscf/hr) | 114,584,700 | 114,496,500 | 111,056,040 |
| Coal Feed (ton/hr) ^b | 490 | 494 | 503 |
| Coal type ^c | Subbituminous | | |
| Boiler configuration ^c | Pulverized, dry bottom | | |
| Coal source ^c | Montana | | |
| SCC | 10100222 | | |
| Control device 1 ^c | Flue Gas Desulfurization, Spray Dryer absorber | | |
| Control device 2 ^c | Baghouse | | |
| Data Quality | A | | |
| Process Parameters ^c | 860 megawatts, on line in 1987. | | |
| Test methods ^c | EPA 101A for mercury | | |
| Number of test runs ^d | 3 | | |

^aPage 18.
^bPage 7.
^cPage 1. Assumed to be dry bottom.
^dPage 5.

| MERCURY EMISSION FACTORS UNIT 3 | | | | |
|---------------------------------------|----------|----------|----------|----------|
| | Run 1 | Run 2 | Run 3 | AVG |
| EMISSION RATES (lb/hr) ^a | 0.038 | 0.043 | 0.044 | |
| EMISSION FACTOR (lb/ton) ^b | 7.76e-05 | 8.70e-05 | 8.75e-05 | 8.40e-05 |

^aPage 5.
^bDivide emission rate by coal feed rate.

REFERENCE 20 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 10 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| PROCESS DATA UNITS 1 & 2 | | | | |
|---|--|-------------|-------------|----------|
| | Run 1 | Run 2 | Run 3 | |
| Vol. Flow Rate (dscf/m) ^a | 3,334,932 | 3,376,641 | 3,313,486 | |
| Vol. Flow Rate (dscf/hr) | 200,095,920 | 202,598,460 | 198,809,160 | |
| Coal Feed (ton/hr) ^b | 764 | 775 | 766 | |
| Coal type ^c | Subbituminous | | | |
| Boiler configuration ^c | Pulverized, assume dry bottom | | | |
| Coal source ^c | 70% Wyoming/30% Montana | | | |
| SCC | 10100222 | | | |
| Control device 1 ^c | Flue Gas Desulfurization, Venturi Scrubber Spray Tower | | | |
| Control device 2 ^c | | | | |
| Data Quality | A | | | |
| Process Parameters ^c | 750 MW each, on line in 1976 | | | |
| Test methods ^c | EPA 101A for mercury | | | |
| Number of test runs ^d | 3 | | | |
| ^a Page 16. ^b Page 7. ^c Page 1. ^d Page 5. | | | | |
| MERCURY EMISSION FACTORS UNIT 1 & 2 | | | | |
| | Run 1 | Run 2 | Run 3 | AVG |
| EMISSION RATES (lb/hr) ^a | 0.042 | 0.025 | 0.090 | |
| EMISSION FACTOR (lb/ton) ^b | 5.50e-05 | 3.23e-05 | 1.17e-04 | 6.82e-05 |
| ^a Page 5. ^b Divide emission rate by coal feed rate. | | | | |

REFERENCE 21 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 11 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: RESULTS OF THE NOVEMBER 5, 1991 AIR TOXIC EMISSION
STUDY ON THE NO. 1, 3 & 4 BOILERS AT THE NSP BLACK
DOG PLANT

FACILITY: NSP BLACK DOG
UNIT NO.: 1, 3 & 4
LOCATION: Burnsville, Minnesota
FILENAME BLKDG134.tbl

| PROCESS DATA | METALS | | |
|---|--|------------|------------|
| | Run 1 | Run 2 | Run 3 |
| Oxygen (% v/v) ^a | 7.10 | 6.80 | 6.60 |
| Vol. Flow Rate (dscf/m) ^b | 836,298 | 842,891 | 824,638 |
| Vol. Flow Rate (dscf/hr) | 50,177,880 | 50,573,460 | 49,478,280 |
| F-factor (dscf/MMBtu) ^c | 9,780 | 9,780 | 9,780 |
| Heat input (MMBtu/hr) | 3,388 | 3,489 | 3,462 |
| HHV Bituminous Coal (Btu/lb) ^d | 8,707 | 8,707 | 8,707 |
| HHV Bituminous Coal (Btu/ton) | 17,414,000 | 17,414,000 | 17,414,000 |
| Coal Feed (ton/hr) | 195 | 200 | 199 |
| Coal type ^e | Subbituminous | | |
| Boiler configuration ^e | Pulverized, dry bottom | | |
| Coal source ^e | Antelope/North Antelope | | |
| SCC | 10100222 | | |
| Control device 1 ^e | ESP | | |
| Control device 2 ^e | ESP | | |
| Data Quality | B Had to use F-factor and average HHV to get coal feed rate, ton/hr. | | |
| Process Parameters ^e | Three watertube boilers at 720,000, 775,000 and 1,250,000 lb/hr steam. | | |
| Test methods ^f | MM 5 metals | | |
| Number of test runs ^g | 3 | | |

^aPage 22.

^bPage 29.

^cPage 29.

^dSection 4 Results of Fuel Analyses.

^ePage 1. Assumed dry bottom.

^fPage 1.

^gVarious pages.

REFERENCE 21 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 11 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS EMISSION FACTORS | | | | |
|-------------------------------------|---------|---------|---------|-----|
| EMISSION RATES (lb/hr) ^a | Run 1 | Run 2 | Run 3 | AVG |
| Aluminum | 8.8 | 9.7 | 10.9 | |
| Antimony ^b | 0.019 | 0.019 | 0.019 | |
| Arsenic | 0.0021 | 0.0021 | 0.0021 | |
| Barium | 0.67 | 0.51 | 0.22 | |
| Beryllium | 0.00036 | 0.00047 | 0.00055 | |
| Boron | 0.11 | 0.099 | 0.12 | |
| Cadmium | 0.0017 | 0.013 | 0.017 | |
| Calcium | 12.6 | 15.2 | 13.2 | |
| Chromium | 0.0071 | 0.013 | 0.009 | |
| Copper | 0.037 | 0.14 | 0.034 | |
| Iron | 3.1 | 3.8 | 4.1 | |
| Lead | 0.017 | 0.19 | 0.0084 | |
| Magnesium | 2.7 | 3.2 | 3.6 | |
| Manganese | 0.019 | 0.021 | 0.022 | |
| Mercury | 0.017 | 0.0087 | 0.022 | |
| Molybdenum ^b | 0.0063 | 0.0063 | 0.0063 | |
| Nickel | 0.012 | 0.052 | 0.0092 | |
| Potassium | 0.52 | 0.93 | 0.65 | |
| Selenium | 0.0042 | 0.0042 | 0.0042 | |
| Silver | 0.0038 | 0.0032 | 0.0078 | |
| SO ₂ | 1490 | 1630 | 1460 | |
| Sodium | 1.5 | 2.5 | 1.9 | |
| Strontium | 0.23 | 0.23 | 0.19 | |
| Vanadium | 0.023 | 0.025 | 0.026 | |
| Zinc | 0.059 | 0.46 | 0.091 | |

REFERENCE 21 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 11 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| EMISSION FACTORS (lb/ton) ^c | Run 1 | Run 2 | Run 3 | AVG |
|--|----------|----------|----------|----------|
| Aluminum | 4.52e-02 | 4.84e-02 | 5.48e-02 | 4.95e-02 |
| Antimony ^b | 9.77e-05 | 9.48e-05 | 9.56e-05 | 9.60e-05 |
| Arsenic | 1.08e-05 | 1.05e-05 | 1.06e-05 | 1.06e-05 |
| Barium | 3.44e-03 | 2.55e-03 | 1.11e-03 | 2.37e-03 |
| Beryllium | 1.85e-06 | 2.35e-06 | 2.77e-06 | 2.32e-06 |
| Boron | 5.65e-04 | 4.94e-04 | 6.04e-04 | 5.54e-04 |
| Cadmium | 8.74e-06 | 6.49e-05 | 8.55e-05 | 5.31e-05 |
| Calcium | 6.48e-02 | 7.59e-02 | 6.64e-02 | 6.90e-02 |
| Chromium | 3.65e-05 | 6.49e-05 | 4.53e-05 | 4.89e-05 |
| Copper | 1.90e-04 | 6.99e-04 | 1.71e-04 | 3.53e-04 |
| Iron | 1.59e-02 | 1.90e-02 | 2.06e-02 | 1.85e-02 |
| Lead | 8.74e-05 | 9.48e-04 | 4.23e-05 | 3.59e-04 |
| Magnesium | 1.39e-02 | 1.60e-02 | 1.81e-02 | 1.60e-02 |
| Manganese | 9.77e-05 | 1.05e-04 | 1.11e-04 | 1.04e-04 |
| Mercury | 8.74e-05 | 4.34e-05 | 1.11e-04 | 8.05e-05 |
| Molybdenum ^b | 3.24e-05 | 3.14e-05 | 3.17e-05 | 3.18e-05 |
| Nickel | 6.17e-05 | 2.60e-04 | 4.63e-05 | 1.23e-04 |
| Potassium | 2.67e-03 | 4.64e-03 | 3.27e-03 | 3.53e-03 |
| Selenium | 2.16e-05 | 2.10e-05 | 2.11e-05 | 2.12e-05 |
| Silver | 1.95e-05 | 1.60e-05 | 3.92e-05 | 2.49e-05 |
| SO2 | 7.66e+00 | 8.14e+00 | 7.34e+00 | 7.71e+0 |
| Sodium | 7.71e-03 | 1.25e-02 | 9.56e-03 | 9.92e-03 |
| Strontium | 1.18e-03 | 1.15e-03 | 9.56e-04 | 1.10e-03 |
| Vanadium | 1.18e-04 | 1.25e-04 | 1.31e-04 | 1.25e-04 |
| Zinc | 3.03e-04 | 2.30e-03 | 4.58e-04 | 1.02e-03 |

^aTable 3 (page 13?).

^bNot detected in any of the sampling runs, emission factor is based on detection limits.

^cDivide emission rate by coal feed rate.

REFERENCE 22 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 12 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: RESULTS OF THE JANUARY 1992 AIR TOXIC EMISSION
STUDY ON THE NO. 2 BOILER AT THE NSP BLACK DOG
PLANT

FACILITY: NSP BLACK DOG
UNIT NO.: 2
LOCATION: Burnsville, Minnesota
FILENAME BLKDOG2.tbl

FILENAME: BERDOG2.01

| PROCESS DATA | METALS | | |
|---|---|---|------------|
| | Run 1 | Run 2 | Run 3 |
| Oxygen (% v/v) ^a | 10.40 | 10.20 | 10.20 |
| Vol. Flow Rate (dscf/m) ^b | 354,118 | 351,097 | 354,635 |
| Vol. Flow Rate (dscf/hr) | 21,247,080 | 21,065,820 | 21,278,100 |
| F-factor (dscf/MMBtu) ^c | 9,780 | 9,780 | 9,780 |
| Heat input (MMBtu/hr) | 1,091 | 1,103 | 1,114 |
| HHV Bituminous Coal (Btu/lb) ^d | 8,553 | 8,553 | 8,553 |
| HHV Bituminous Coal (Btu/ton) | 17,106,000 | 17,106,000 | 17,106,000 |
| Coal Feed (ton/hr) | 64 | 64 | 65 |
| Coal type ^e | Subbituminous | | |
| Boiler configuration ^e | Atmospheric Fluidized bed Combustor (AFBC), circulating bed | | |
| Coal source ^e | Antelope/North Antelope | | |
| SCC | 10100238 | | |
| Control Device 1 ^e | Cyclone (mechanical dust collector) | | |
| Control device 2 ^e | ESP | | |
| Control device 3 ^e | ESP | | |
| Data Quality | B | Had to use F-factor and average HHV to get coal feed rate (ton/hr). | |
| Process Parameters ^e | 137 MW | | |
| Test methods ^f | MM 5 metals. | | |
| Number of test runs ^g | 2 for lead, 3 for all others | | |

^aPage 20.
^bPage 25.
^cPage 25.
^dPage 31
^ePage 1. Coal from Antelope/Northern Antelope is subbituminous, according to another report.
^fPage 1.
^gVarious pages.

REFERENCE 22 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 12 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS EMISSION FACTORS | | | | |
|-------------------------------------|----------|----------|----------|-----|
| EMISSION RATES (lb/hr) ^a | Run 1 | Run 2 | Run 3 | AVG |
| Aluminum | 1.05 | 1.29 | 1.33 | |
| Antimony ^b | 0.0006 | 0.0006 | 0.0006 | |
| Arsenic | 0.000584 | 0.000603 | 0.000559 | |
| Barium | 0.0541 | 0.0639 | 0.0691 | |
| Beryllium ^b | 0.00003 | 0.00003 | 0.00003 | |
| Boron | 0.0927 | 0.101 | 0.0847 | |
| Cadmium | 0.00403 | 0.0117 | 0.00575 | |
| Calcium | 4.05 | 4.59 | 4.76 | |
| Chromium | 0.00573 | 0.0112 | 0.00386 | |
| Copper | 0.0139 | 0.0177 | 0.0113 | |
| Iron | 0.969 | 1.04 | 1.15 | |
| Lead | 0.0496 | | 0.0613 | |
| Magnesium | 0.704 | 0.812 | 0.835 | |
| Manganese | 0.00529 | 0.00615 | 0.00895 | |
| Mercury | 0.0029 | 0.00265 | 0.00297 | |
| Molybdenum | 0.0064 | 0.0135 | 0.0051 | |
| Nickel | 0.0376 | 0.0471 | 0.01 | |
| Potassium | 0.07 | 0.107 | 0.0901 | |
| Selenium | 0.000602 | 0.000299 | 0.000445 | |
| Silver ^b | 0.0006 | 0.0006 | 0.0006 | |
| SO ₂ | 362 | 356 | 334 | |
| Sodium | 0.837 | 0.983 | 0.829 | |
| Strontium | 0.056 | 0.0651 | 0.0733 | |
| Vanadium | 0.00437 | 0.00434 | 0.00436 | |
| Zinc | 0.122 | 0.092 | 0.0479 | |

REFERENCE 22 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 12 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| EMISSION FACTORS (lb/ton) ^c | Run 1 | Run 2 | Run 3 | AVG |
|--|----------|----------|----------|----------|
| Aluminum | 1.65e-02 | 2.00e-02 | 2.04e-02 | 1.90e-02 |
| Antimony ^b | 9.40e-06 | 9.31e-06 | 9.21e-06 | 9.31e-06 |
| Arsenic | 9.15e-06 | 9.35e-06 | 8.58e-06 | 9.03e-06 |
| Barium | 8.48e-04 | 9.91e-04 | 1.06e-03 | 9.67e-04 |
| Beryllium ^b | 4.70e-07 | 4.65e-07 | 4.61e-07 | 4.65e-07 |
| Boron | 1.45e-03 | 1.57e-03 | 1.30e-03 | 1.44e-03 |
| Cadmium | 6.32e-05 | 1.81e-04 | 8.83e-05 | 1.11e-04 |
| Calcium | 6.35e-02 | 7.12e-02 | 7.31e-02 | 6.93e-02 |
| Chromium | 8.98e-05 | 1.74e-04 | 5.93e-05 | 1.08e-04 |
| Copper | 2.18e-04 | 2.75e-04 | 1.74e-04 | 2.22e-04 |
| Iron | 1.52e-02 | 1.61e-02 | 1.77e-02 | 1.63e-02 |
| Lead | 7.77e-04 | | 9.41e-04 | 8.59e-04 |
| Magnesium | 1.10e-02 | 1.26e-02 | 1.28e-02 | 1.22e-02 |
| Manganese | 8.29e-05 | 9.54e-05 | 1.37e-04 | 1.05e-04 |
| Mercury | 4.55e-05 | 4.11e-05 | 4.56e-05 | 4.41e-05 |
| Molybdenum | 1.00e-04 | 2.09e-04 | 7.83e-05 | 1.29e-04 |
| Nickel | 5.89e-04 | 7.31e-04 | 1.54e-04 | 4.91e-04 |
| Potassium | 1.10e-03 | 1.66e-03 | 1.38e-03 | 1.38e-03 |
| Selenium | 9.43e-06 | 4.64e-06 | 6.83e-06 | 6.97e-06 |
| Silver ^b | 9.40e-06 | 9.31e-06 | 9.21e-06 | 9.31e-06 |
| SO2 | 5.67e+00 | 5.52e+00 | 5.13e+00 | 5.44e+00 |
| Sodium | 1.31e-02 | 1.52e-02 | 1.27e-02 | 1.37e-02 |
| Strontium | 8.78e-04 | 1.01e-03 | 1.13e-03 | 1.00e-03 |
| Vanadium | 6.85e-05 | 6.73e-05 | 6.70e-05 | 6.76e-05 |
| Zinc | 1.91e-03 | 1.43e-03 | 7.36e-04 | 1.36e-03 |

^aPage 11

^bPollutant was not detected in any of the sampling runs, detection limits used to develop rates.

^cDivide emission rate by coal feed rate.

REFERENCE 23 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 13 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: RESULTS OF THE NOVEMBER 7, 1991 AIR TOXIC EMISSION
STUDY ON THE NOS. 3, 4, 5 & 6 BOILERS AT THE NSP HIGH
BRIDGE PLANT

FACILITY: NSP High Bridge
UNIT NO.: 3, 4, 5 & 6
LOCATION: St. Paul, Minnesota
FILENAME HIBRIDGE.tbl

| PROCESS DATA | METALS | | |
|---|--|------------|------------|
| | Run 1 | Run 2 | Run 3 |
| Oxygen (% v/v) ^a | 7.70 | 7.60 | 7.80 |
| Vol. Flow Rate (dscf/m) ^b | 804,786 | 788,668 | 815,076 |
| Vol. Flow Rate (dscf/hr) | 48,287,160 | 47,320,080 | 48,904,560 |
| F-factor (dscf/MMBtu) ^c | 9,780 | 9,780 | 9,780 |
| Heat input (MMBtu/hr) | 3,118 | 3,079 | 3,134 |
| HHV Bituminous Coal (Btu/lb) ^d | 8,498 | 8,498 | 8,498 |
| HHV Bituminous Coal (Btu/ton) | 16,996,000 | 16,996,000 | 16,996,000 |
| Coal Feed (ton/hr) | 183 | 181 | 184 |
| Coal type ^e | Subbituminous | | |
| Boiler configuration ^e | Pulverized, dry bottom | | |
| Coal source ^e | Rochelle | | |
| SCC | 10100222 | | |
| Control device 1 ^e | ESPC | | |
| Control device 2 ^e | None | | |
| Data Quality | B Had to use F-factor and average HHV to get coal feed rate, ton/hr. | | |
| Process Parameters ^e | Watertube boilers with economizers and air preheaters | | |
| Test methods ^f | MM 5 metals, Method 18 for BTEX | | |
| Number of test runs ^g | 3 | | |

^aPage 29.

^bPage 37.

^c40 CFR Pt 60, App A, Meth. 19

^dPage 42

^ePage 1. Assumed dry bottom.

^fPage 1 for metals, page 3 for BTEX.

^gVarious pages.

REFERENCE 23 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 13 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS EMISSION FACTORS | | | | |
|-------------------------------------|---------|---------|---------|-----|
| EMISSION RATES (lb/hr) ^a | Run 1 | Run 2 | Run 3 | AVG |
| Aluminum | 4.17 | 3.24 | 4.63 | |
| Antimony | 0.00126 | 0.00456 | 0.00092 | |
| Arsenic | 0.00126 | 0.00091 | 0.00092 | |
| Barium | 0.406 | 0.350 | 0.433 | |
| Beryllium | 0.00018 | 0.00018 | 0.00037 | |
| Boron | 0.127 | 0.105 | 0.118 | |
| Cadmium | 0.0023 | 0.0018 | 0.002 | |
| Calcium | 5.25 | 4.12 | 6.45 | |
| Chromium | 0.023 | 0.018 | 0.024 | |
| Copper | 0.036 | 0.024 | 0.028 | |
| Iron | 1.66 | 1.42 | 1.55 | |
| Lead | 0.015 | 0.0091 | 0.0092 | |
| Magnesium | 1.03 | 0.82 | 1.14 | |
| Manganese | 0.033 | 0.015 | 0.028 | |
| Mercury ^b | 0.013 | 0.010 | 0.013 | |
| Molybdenum | 0.059 | 0.046 | 0.061 | |
| Nickel | 0.012 | 0.0091 | 0.011 | |
| Potassium | 0.54 | 0.38 | 0.49 | |
| Selenium | 0.0036 | 0.0018 | 0.0018 | |
| Silver | 0.072 | 0.051 | 0.037 | |
| SO ₂ | 1,319 | 1,290 | 1,247 | |
| Sodium | 1.22 | 1.02 | 1.40 | |
| Strontium | 0.17 | 0.12 | 0.15 | |
| Vanadium | 0.0066 | 0.0067 | 0.0068 | |
| Zinc | 0.074 | 0.049 | 0.050 | |

REFERENCE 23 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 13 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| EMISSION FACTORS (lb/ton) ^c | Run 1 | Run 2 | Run 3 | AVG |
|--|----------|----------|----------|----------|
| Aluminum | 2.27e-02 | 1.79e-02 | 2.51e-02 | 2.19e-02 |
| Antimony | 6.87e-06 | 2.52e-05 | 4.99e-06 | 1.23e-05 |
| Arsenic | 6.87e-06 | 5.02e-06 | 4.99e-06 | 5.63e-06 |
| Barium | 2.21e-03 | 1.93e-03 | 2.35e-03 | 2.16e-03 |
| Beryllium | 9.81e-07 | 9.94e-07 | 2.01e-06 | 1.33e-06 |
| Boron | 6.92e-04 | 5.80e-04 | 6.40e-04 | 6.37e-04 |
| Cadmium | 1.25e-05 | 9.94e-06 | 1.08e-05 | 1.11e-05 |
| Calcium | 2.86e-02 | 2.27e-02 | 3.50e-02 | 2.88e-02 |
| Chromium | 1.25e-04 | 9.94e-05 | 1.30e-04 | 1.18e-04 |
| Copper | 1.96e-04 | 1.32e-04 | 1.52e-04 | 1.60e-04 |
| Iron | 9.05e-03 | 7.84e-03 | 8.41e-03 | 8.43e-03 |
| Lead | 8.18e-05 | 5.02e-05 | 4.99e-05 | 6.06e-05 |
| Magnesium | 5.61e-03 | 4.53e-03 | 6.18e-03 | 5.44e-03 |
| Manganese | 1.80e-04 | 8.28e-05 | 1.52e-04 | 1.38e-04 |
| Mercury ^b | 7.09e-05 | 5.52e-05 | 7.05e-05 | 6.55e-05 |
| Molybdenum | 3.22e-04 | 2.54e-04 | 3.31e-04 | 3.02e-04 |
| Nickel | 6.54e-05 | 5.02e-05 | 5.96e-05 | 5.84e-05 |
| Potassium | 2.94e-03 | 2.10e-03 | 2.66e-03 | 2.57e-03 |
| Selenium | 1.96e-05 | 9.94e-06 | 9.76e-06 | 1.31e-05 |
| Silver | 3.92e-04 | 2.82e-04 | 2.01e-04 | 2.92e-04 |
| SO2 | 7.19e+00 | 7.12e+00 | 6.76e+00 | 7.02e+00 |
| Sodium | 6.65e-03 | 5.63e-03 | 7.59e-03 | 6.62e-03 |
| Strontium | 9.27e-04 | 6.62e-04 | 8.13e-04 | 8.01e-04 |
| Vanadium | 3.60e-05 | 3.70e-05 | 3.69e-05 | 3.66e-05 |
| Zinc | 4.03e-04 | 2.70e-04 | 2.71e-04 | 3.15e-04 |

^aTable 4, page 16.
^bPollutant not detected in any of the sampling runs, detection limit used to develop emission factor.
^cDivide emission rate by coal feed rate.

REFERENCE 23 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 13 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| BTEX EMISSION FACTORS | | | | |
|--|----------|----------|----------|----------|
| EMISSION RATES (lb/hr) ^a | Run 1 | Run 2 | Run 3 | |
| Benzene ^b | 0.2 | 0.2 | 0.2 | |
| Toluene ^b | 0.2 | 0.2 | 0.2 | |
| Ethyl Benzene ^b | 0.2 | 0.2 | 0.2 | |
| Xylene ^b | 0.2 | 0.2 | 0.2 | |
| ^a page 22 | | | | |
| EMISSION FACTORS (lb/ton) ^c | Run 1 | Run 2 | Run 3 | AVG |
| Benzene ^b | 1.09e-03 | 1.10e-03 | 1.08e-03 | 1.09e-03 |
| Toluene ^b | 1.09e-03 | 1.10e-03 | 1.08e-03 | 1.09e-03 |
| Ethyl Benzene ^b | 1.09e-03 | 1.10e-03 | 1.08e-03 | 1.09e-03 |
| Xylene ^b | 1.09e-03 | 1.10e-03 | 1.08e-03 | 1.09e-03 |
| ^a page 22 ^b Pollutant was not detected in any of the sampling runs, detection limits used to develop emission factor. ^c Divide emission rate by coal feed rate. | | | | |

REFERENCE 24 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 14 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: RESULTS OF THE DECEMBER 1991 AIR TOXIC EMISSION
STUDY ON UNITS 6 & 7 AT THE NSP RIVERSIDE PLANT

FACILITY: NSP Riverside
UNIT NO.: 6, 7
LOCATION: Minneapolis, Mn
FILENAME RIVERSID.tbl

PROCESS DATA

| | |
|-----------------------------------|---|
| Coal type ^a | Subbituminous |
| Boiler configuration ^a | Pulverized, dry bottom |
| Coal source ^a | Rochelle |
| SCC | 10100222 |
| Control device 1 ^b | Baghouse |
| Control device 2 ^b | None |
| Data Quality | B Had to use F-factor and average HHV to get coal feed rate (ton/hr) |
| Process Parameters ^a | 575,000 lb/hr steam each; equipped with economizers and air preheaters. |
| Test methods ^c | MM5 for PM/Metals, Method 18 for BTEX. |
| Number of test runs ^d | 3 |

FLOW RATES, COAL FEED RATES

| | Unit 6 | | |
|--|------------|------------|------------|
| | Run 1 | Run 2 | Run 3 |
| Volumetric flow rate (dscf/m) ^e | 193,851 | 189,541 | 187,122 |
| Volumetric flow rate (dscf/hr) | 11,631,060 | 11,372,460 | 11,227,320 |
| F-Factor (dscf/MMBtu) ^f | 9,780 | 9,780 | 9,780 |
| O2 %v/v ^g | 6.00 | 6.00 | 6.60 |
| Heat input (MMBtu/hr) | 848 | 829 | 785 |
| Coal HHV (Btu/lb) ^h | 8,602 | 8,602 | 8,602 |
| Coal HHV (Btu/ton) | 17,204,000 | 17,204,000 | 17,204,000 |
| Coal feed rate (ton/hr) | 49.28 | 48.19 | 45.66 |

REFERENCE 24 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 14 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| | Unit 7 | | | |
|--|------------|------------|------------|-----|
| | Run 1 | Run 2 | Run 3 | |
| Volumetric flow rate (dscf/m) ^c | 188,847 | 188,814 | 194,376 | |
| Volumetric flow rate (dscf/hr) | 11,330,820 | 11,328,840 | 11,662,560 | |
| F-Factor (dscf/MMBtu) ^f | 9,780 | 9,780 | 9,780 | |
| O2 %v/v ^g | 6.30 | 6.20 | 6.30 | |
| Heat input (MMBtu/hr) | 809 | 815 | 833 | |
| Coal HHV (Btu/lb) ^h | 8,602 | 8,602 | 8,602 | |
| Coal HHV (Btu/ton) | 17,204,000 | 17,204,000 | 17,204,000 | |
| Coal feed rate (ton/hr) | 47.04 | 47.36 | 48.42 | |
| ^a Page 1. Assumed dry bottom. ^b Page 2. ^c Page 1, 3, 24. ^d Various pages. ^e Page 29 for Unit 6 metals, Page 30 for Unit 7 metals. ^f Page 28. ^g Page 23 for Unit 6 metals, Page 24 for Unit 7 metals. ^h Page 36. | | | | |
| METALS EMISSION FACTORS UNITS 6 & 7 | | | | |
| EMISSION RATES (lb/hr) ^a | Run 1 | Run 2 | Run 3 | AVG |
| Aluminum | 13.9 | 16.7 | 15.5 | |
| Antimony | 0.00075 | 0.00067 | 0.00024 | |
| Arsenic | 0.00174 | 0.00183 | 0.00183 | |
| Barium | 0.073 | 0.005 | 0.002 | |
| Beryllium | 0.00073 | 0.0007 | 0.00088 | |
| Boron | 0.132 | 0.022 | 0.007 | |
| Cadmium | 0.115 | 0.0141 | 0.0101 | |
| Calcium | 23.4 | 27.7 | 19.0 | |
| Chromium | 0.0228 | 0.0209 | 0.0234 | |
| Copper | 0.060 | 0.065 | 0.053 | |
| Iron | 5.5 | 6.7 | 5.9 | |
| Lead | 0.0134 | 0.0100 | 0.0096 | |
| Magnesium | 4.9 | 5.9 | 5.3 | |
| Manganese | 0.0298 | 0.0400 | 0.0252 | |

REFERENCE 24 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 14 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS EMISSION FACTORS UNITS 6 & 7 | | | | |
|--|----------|----------|----------|----------|
| EMISSION RATES (lb/hr) ^a | Run 1 | Run 2 | Run 3 | AVG |
| Mercury | 0.013 | 0.006 | 0.005 | |
| Molybdenum | 0.00198 | 0.00409 | 0.00434 | |
| Nickel | 0.0285 | 0.113 | 0.0234 | |
| Potassium | 0.55 | 0.78 | 0.61 | |
| Selenium | 0.00706 | 0.00289 | 0.00193 | |
| Silver | 0.005 | 0.002 | 0.002 | |
| SO ₂ | 875 | 788 | 762 | |
| Sodium | 2.03 | 2.85 | 2.49 | |
| Strontium | 0.328 | 0.372 | 0.256 | |
| Vanadium | 0.0289 | 0.0390 | 0.0347 | |
| Zinc | 0.071 | 0.278 | 0.006 | |
| EMISSION FACTORS (lb/ton) ^b | Run 1 | Run 2 | Run 3 | AVG |
| Aluminum | 1.44e-01 | 1.75e-01 | 1.65e-01 | 1.61e-01 |
| Antimony | 7.79e-06 | 7.01e-06 | 2.55e-06 | 5.78e-06 |
| Arsenic | 1.81e-05 | 1.92e-05 | 1.95e-05 | 1.89e-05 |
| Barium | 7.58e-04 | 5.23e-05 | 2.13e-05 | 2.77e-04 |
| Beryllium | 7.58e-06 | 7.33e-06 | 9.35e-06 | 8.09e-06 |
| Boron | 1.37e-03 | 2.30e-04 | 7.44e-05 | 5.58e-04 |
| Cadmium | 1.19e-03 | 1.48e-04 | 1.07e-04 | 4.83e-04 |
| Calcium | 2.43e-01 | 2.90e-01 | 2.02e-01 | 2.45e-01 |
| Chromium | 2.37e-04 | 2.19e-04 | 2.49e-04 | 2.35e-04 |
| Copper | 6.23e-04 | 6.80e-04 | 5.63e-04 | 6.22e-04 |
| Iron | 5.71e-02 | 7.01e-02 | 6.27e-02 | 6.33e-02 |
| Lead | 1.39e-04 | 1.05e-04 | 1.02e-04 | 1.15e-04 |
| Magnesium | 5.09e-02 | 6.18e-02 | 5.63e-02 | 5.63e-02 |
| Manganese | 3.09e-04 | 4.19e-04 | 2.68e-04 | 3.32e-04 |
| Mercury | 1.35e-04 | 6.28e-05 | 5.31e-05 | 8.36e-05 |
| Molybdenum | 2.06e-05 | 4.28e-05 | 4.61e-05 | 3.65e-05 |
| Nickel | 2.96e-04 | 1.18e-03 | 2.49e-04 | 5.76e-04 |

REFERENCE 24 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 14 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| EMISSION FACTORS (lb/ton) ^b | Run 1 | Run 2 | Run 3 | AVG |
|--|----------|----------|----------|----------|
| Potassium | 5.71e-03 | 8.16e-03 | 6.48e-03 | 6.79e-03 |
| Selenium | 7.33e-05 | 3.02e-05 | 2.05e-05 | 4.14e-05 |
| Silver | 5.19e-05 | 2.09e-05 | 2.13e-05 | 3.14e-05 |
| SO ₂ | 9.08e+00 | 8.25e+00 | 8.10e+00 | 8.48e+00 |
| Sodium | 2.11e-02 | 2.98e-02 | 2.65e-02 | 2.58e-02 |
| Strontium | 3.41e-03 | 3.89e-03 | 2.72e-03 | 3.34e-03 |
| Vanadium | 3.00e-04 | 4.08e-04 | 3.69e-04 | 3.59e-04 |
| Zinc | 7.37e-04 | 2.91e-03 | 6.38e-05 | 1.24e-03 |
| ^a Table 8, page 16. ^b Divide emission rate by coal feed rate. | | | | |
| BTEX EMISSION FACTORS UNIT 6 | | | | |
| Emission Rates (lb/hr) ^a | Run 1 | Run 2 | Run 3 | |
| Benzene | 1.02 | 1.05 | 0.33 | |
| Toluene ^b | 0.06 | 0.06 | 0.06 | |
| Ethylbenzene ^b | 0.06 | 0.06 | 0.06 | |
| Xylene ^b | 0.06 | 0.06 | 0.06 | |
| Emission Factors (lb/ton) ^c | | | | avg |
| Benzene | 2.07e-02 | 2.18e-02 | 7.23e-03 | 1.66e-02 |
| Toluene ^b | 1.22e-03 | 1.25e-03 | 1.31e-03 | 1.26e-03 |
| Ethylbenzene ^b | 1.22e-03 | 1.25e-03 | 1.31e-03 | 1.26e-03 |
| Xylene ^b | 1.22e-03 | 1.25e-03 | 1.31e-03 | 1.26e-03 |
| ^a page 19. ^b Pollutant was not detected in any of the sampling runs. EF is based on detection limits. ^c Divide emission rate by coal feed rate. | | | | |
| BTEX EMISSION FACTORS UNIT 7 | | | | |
| Emission Rates (lb/hr) ^a | Run 1 | Run 2 | Run 3 | |
| Benzene ^b | 0.06 | 0.06 | 0.06 | |
| Toluene ^b | 0.06 | 0.06 | 0.06 | |
| Ethylbenzene ^b | 0.06 | 0.06 | 0.06 | |
| Xylene ^b | 0.06 | 0.06 | 0.06 | |

REFERENCE 24 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 14 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| Emission Factors (lb/ton) ^c | | | | |
|--|----------|----------|----------|----------|
| Benzene ^b | 1.28e-03 | 1.27e-03 | 1.24e-03 | 1.26e-03 |
| Toluene ^b | 1.28e-03 | 1.27e-03 | 1.24e-03 | 1.26e-03 |
| Ethylbenzene ^b | 1.28e-03 | 1.27e-03 | 1.24e-03 | 1.26e-03 |
| Xylene ^b | 1.28e-03 | 1.27e-03 | 1.24e-03 | 1.26e-03 |
| ^a page 19. ^b Pollutant was not detected in any of the sampling runs. EF is based on detection limits. ^c Divide emission rate by coal feed rate. | | | | |

REFERENCE 25 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 15 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: RESULTS OF THE MAY 29, 1990 TRACE METAL
CHARACTERIZATION STUDY ON UNITS 1 AND 2 AT THE
SHERBURNE COUNTY GENERATING STATION IN BECKER,
MINNESOTA

FACILITY: NSP Sherco
UNIT NO.: 1, 2
LOCATION: Becker, Minnesota
FILENAME SHERCO12.tbl

| PROCESS DATA | PM/METALS | | |
|---|--|--|-------------|
| | Run 1 | Run 2 | Run 3 |
| Oxygen (% v/v) ^a | 6.60 | 6.50 | 6.60 |
| Vol. Flow Rate (dscf/m) ^b | 3,305,953 | 3,340,203 | 3,106,503 |
| Vol. Flow Rate (dscf/hr) | 198,357,180 | 200,412,180 | 186,390,180 |
| F-factor (dscf/MMBtu) ^c | 9,780 | 9,780 | 9,780 |
| Heat input (MMBtu/hr) | 13,877 | 14,119 | 13,040 |
| HHV Bituminous Coal (Btu/lb) ^d | 8,547 | 8,547 | 8,547 |
| HHV Bituminous Coal (Btu/ton) | 17,094,000 | 17,094,000 | 17,094,000 |
| Coal Feed (ton/hr) | 812 | 826 | 763 |
| Coal type ^e | Subbituminous | | |
| Boiler configuration ^e | Pulverized, dry bottom | | |
| Coal source ^e | 80 % Rochelle/20 % Coalstrip | | |
| SCC | 10100222 | | |
| Control device 1 ^e | Flue Gas Desulfurization, Venturi Scrubber Spray Tower | | |
| Control device 2 ^e | None | | |
| Data Quality | B | Had to use F-factor and average HHV to get coal feed rate, ton/hr. | |
| Process Parameters ^e | 750 MW each, on line in 1976. | | |
| Test methods ^f | MM 5 | | |
| Number of test runs ^g | 2 for nickel, 3 for all others | | |

^aPage 7.

^bPage 8.

^c40 CFR Pt 60, App A.

^dPage G-1.

^ePage 1.

^fPage 1.

^gVarious pages.

REFERENCE 25 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 15 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS EMISSION FACTORS | | | | |
|---|---------|----------|---------|-----|
| EMISSION RATES (lb/hr) ^a | Run 1 | Run 2 | Run 3 | AVG |
| Aluminum | 8.9725 | 23.3877 | 7.7052 | |
| Antimony | 0.0084 | 0.0041 | 0.0092 | |
| Arsenic | 0.0304 | 0.0433 | 0.0326 | |
| Barium | 3.3101 | 6.4375 | 2.6330 | |
| Beryllium | 0.0033 | 0.0036 | 0.0035 | |
| Boron | 4.1097 | 86.2852 | 43.3077 | |
| Cadmium | 0.0205 | 0.0132 | 0.0097 | |
| Calcium | 67.2241 | 141.6439 | 72.3851 | |
| Chromium | 0.2046 | 0.1788 | 0.0881 | |
| Copper | 0.1302 | 0.1694 | 0.1321 | |
| Iron | 10.3672 | 13.7879 | 9.5545 | |
| Lead | 0.1116 | 0.0941 | 0.0969 | |
| Magnesium | 7.0757 | 18.5219 | 6.6221 | |
| Manganese | 0.3068 | 0.3294 | 0.6076 | |
| Mercury | 0.0093 | 0.0196 | 0.0141 | |
| Molybdenum | 0.0279 | 0.0471 | 0.0264 | |
| Nickel | 0.0186 | ---- | 0.0185 | |
| Potassium | 1.5806 | 2.0705 | 1.8493 | |
| Selenium | 0.0818 | 0.1129 | 0.1233 | |
| Silver ^b | 0.0112 | 0.0113 | 0.0114 | |
| Sodium | 4.7419 | 6.8704 | 5.4597 | |
| Strontium | 2.5197 | 4.5928 | 2.4657 | |
| Vanadium | 0.2603 | 0.3294 | 0.2906 | |
| Zinc | 0.2696 | 0.3106 | 0.2378 | |
| ^a Page 5. | | | | |
| ^b Pollutant was not detected in any of the sampling runs. EF is based on detection limits. | | | | |

REFERENCE 25 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 15 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| EMISSION FACTORS (lb/ton) ^c | Run 1 | Run 2 | Run 3 | AVG |
|---|----------|----------|----------|----------|
| Aluminum | 1.11e-02 | 2.83e-02 | 1.01e-02 | 1.65e-02 |
| Antimony | 1.03e-05 | 4.96e-06 | 1.21e-05 | 9.12e-06 |
| Arsenic | 3.74e-05 | 5.24e-05 | 4.27e-05 | 4.42e-05 |
| Barium | 4.08e-03 | 7.79e-03 | 3.45e-03 | 5.11e-03 |
| Beryllium | 4.06e-06 | 4.36e-06 | 4.59e-06 | 4.34e-06 |
| Boron | 5.06e-03 | 1.04e-01 | 5.68e-02 | 5.54e-02 |
| Cadmium | 2.53e-05 | 1.60e-05 | 1.27e-05 | 1.80e-05 |
| Calcium | 8.28e-02 | 1.71e-01 | 9.49e-02 | 1.16e-01 |
| Chromium | 2.52e-04 | 2.16e-04 | 1.15e-04 | 1.95e-04 |
| Copper | 1.60e-04 | 2.05e-04 | 1.73e-04 | 1.80e-04 |
| Iron | 1.28e-02 | 1.67e-02 | 1.25e-02 | 1.40e-02 |
| Lead | 1.37e-04 | 1.14e-04 | 1.27e-04 | 1.26e-04 |
| Magnesium | 8.72e-03 | 2.24e-02 | 8.68e-03 | 1.33e-02 |
| Manganese | 3.78e-04 | 3.99e-04 | 7.97e-04 | 5.24e-04 |
| Mercury | 1.15e-05 | 2.37e-05 | 1.85e-05 | 1.79e-05 |
| Molybdenum | 3.44e-05 | 5.70e-05 | 3.46e-05 | 4.20e-05 |
| Nickel | 2.29e-05 | | 2.43e-05 | 2.36e-05 |
| Potassium | 1.95e-03 | 2.51e-03 | 2.42e-03 | 2.29e-03 |
| Selenium | 1.01e-04 | 1.37e-04 | 1.62e-04 | 1.33e-04 |
| Silver ^b | 1.38e-05 | 1.37e-05 | 1.49e-05 | 1.41e-05 |
| Sodium | 5.84e-03 | 8.32e-03 | 7.16e-03 | 7.11e-03 |
| Strontium | 3.10e-03 | 5.56e-03 | 3.23e-03 | 3.97e-03 |
| Vanadium | 3.21e-04 | 3.99e-04 | 3.81e-04 | 3.67e-04 |
| Zinc | 3.32e-04 | 3.76e-04 | 3.12e-04 | 3.40e-04 |
| ^a Page 5. ^b Pollutant was not detected in any of the sampling runs. EF is based on detection limits. ^c Divide emission rate by coal feed rate. | | | | |

REFERENCE 26 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 16 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: RESULTS OF THE MAY 1, 1990 TRACE METAL
CHARACTERIZATION STUDY ON UNITS 1 AND 2 AT THE
SHERBURNE COUNTY GENERATING STATION

FACILITY: NSP Sherco
UNIT NO.: 1, 2
LOCATION: Becker, Minnesota
FILENAME SHRCO12A.TBL

| PROCESS DATA | METALS | | |
|---|--|--|-------------|
| | Run 1 | Run 2 | Run 3 |
| Oxygen (% v/v) ^a | 6.60 | 6.60 | 6.70 |
| Vol. Flow Rate (dscf/m) ^b | 3,284,153 | 3,326,471 | 3,347,367 |
| Vol. Flow Rate (dscf/hr) | 197,049,180 | 199,588,260 | 200,842,020 |
| F-factor (dscf/MMBtu) ^c | 9,780 | 9,780 | 9,780 |
| Heat input (MMBtu/hr) | 13,786 | 13,963 | 13,953 |
| HHV Bituminous Coal (Btu/lb) ^d | 8,547 | 8,547 | 8,547 |
| HHV Bituminous Coal (Btu/ton) | 17,094,000 | 17,094,000 | 17,094,000 |
| Coal Feed (ton/hr) | 806 | 817 | 816 |
| Coal type ^e | Subbituminous | | |
| Boiler configuration ^e | Pulverized, dry bottom | | |
| Coal source | no data | | |
| SCC | 10100222 | | |
| Control device 1 ^e | Flue Gas Desulfurization, Venturi Scrubber Spray Tower | | |
| Control device 2 ^e | None | | |
| Data Quality | B | Had to use F-factor and average HHV to get coal feed rate, ton/hr. | |
| Process Parameters ^e | 750 MW each, on line in 1976. | | |
| Test methods ^f | MM 5 metals. | | |
| Number of test runs ^g | 2 for cadmium, nickel, copper and zinc; 3 for all others | | |

^aPage 14.

^bPage 19.

^c40 CFR Pt 60, App A.

^dFrom report "Results of the May 29, 1990 Trace Metal Characterization Study on Units 1 and 2 at the Sherburne County Generating Station in Becker, Minnesota", page G-1. (Reference No. 25)

^ePage 1 of "Results of the September 10 and 11, 1991 Mercury Removal Tests on the Units 1 & 2, and Unit 3 Scrubber Systems at the NSP Sherco Plant in Becker, Minnesota" (Reference 19). Dry bottom assumed.

^fPage 2.

^gVarious pages.

REFERENCE 26 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 16 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS EMISSION FACTORS | | | | |
|-------------------------------------|--------|--------|--------|-----|
| EMISSION RATES (lb/hr) ^a | Run 1 | Run 2 | Run 3 | AVG |
| Aluminum | 9.58 | 11.06 | 8.86 | |
| Antimony | 0.016 | 0.011 | 0.009 | |
| Arsenic | 0.035 | 0.039 | 0.030 | |
| Barium | 3.59 | 5.81 | 2.25 | |
| Beryllium | 0.0037 | 0.0042 | 0.0038 | |
| Boron | 98.0 | 18.1 | 38.1 | |
| Cadmium | --- | 0.029 | 0.049 | |
| Calcium | 126 | 141 | 129 | |
| Chromium | 0.133 | 0.101 | 0.092 | |
| Copper | --- | 0.200 | 0.227 | |
| Iron | 14.6 | 14.6 | 12.9 | |
| Lead | 0.127 | 0.118 | 0.100 | |
| Magnesium | 5.36 | 7.65 | 5.91 | |
| Manganese | 0.281 | 0.401 | 0.273 | |
| Mercury | 0.092 | 0.078 | 0.063 | |
| Molybdenum ^b | 0.027 | 0.027 | 0.027 | |
| Nickel | --- | 0.071 | 0.052 | |
| Potassium | 2.00 | 1.88 | 1.74 | |
| Selenium | 0.109 | 0.137 | 0.118 | |
| Silver | 0.009 | 0.010 | 0.030 | |
| Sodium | 7.67 | 6.42 | 5.13 | |
| Strontium | 3.26 | 3.82 | 3.09 | |
| Vanadium | 0.300 | 0.291 | 0.282 | |
| Zinc | --- | 0.70 | 0.45 | |

REFERENCE 26 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 16 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| EMISSION FACTORS (lb/ton) ^c | Run 1 | Run 2 | Run 3 | AVG |
|---|----------|----------|----------|----------|
| Aluminum | 1.19e-02 | 1.35e-02 | 1.09e-02 | 1.21e-02 |
| Antimony | 1.98e-05 | 1.35e-05 | 1.10e-05 | 1.48e-05 |
| Arsenic | 4.34e-05 | 4.77e-05 | 3.68e-05 | 4.26e-05 |
| Barium | 4.45e-03 | 7.11e-03 | 2.76e-03 | 4.77e-03 |
| Beryllium | 4.59e-06 | 5.14e-06 | 4.66e-06 | 4.80e-06 |
| Boron | 1.22e-01 | 2.22e-02 | 4.67e-02 | 6.35e-02 |
| Cadmium | | 3.55e-05 | 6.00e-05 | 4.78e-05 |
| Calcium | 1.56e-01 | 1.73e-01 | 1.58e-01 | 1.62e-01 |
| Chromium | 1.65e-04 | 1.24e-04 | 1.13e-04 | 1.34e-04 |
| Copper | | 2.45e-04 | 2.78e-04 | 2.61e-04 |
| Iron | 1.81e-02 | 1.79e-02 | 1.58e-02 | 1.73e-02 |
| Lead | 1.57e-04 | 1.44e-04 | 1.23e-04 | 1.41e-04 |
| Magnesium | 6.65e-03 | 9.37e-03 | 7.24e-03 | 7.75e-03 |
| Manganese | 3.48e-04 | 4.91e-04 | 3.34e-04 | 3.91e-04 |
| Mercury | 1.14e-04 | 9.55e-05 | 7.72e-05 | 9.56e-05 |
| Molybdenum ^b | 3.35e-05 | 3.31e-05 | 3.31e-05 | 3.32e-05 |
| Nickel | | 8.69e-05 | 6.37e-05 | 7.53e-05 |
| Potassium | 2.48e-03 | 2.30e-03 | 2.13e-03 | 2.30e-03 |
| Selenium | 1.35e-04 | 1.68e-04 | 1.45e-04 | 1.49e-04 |
| Silver | 1.12e-05 | 1.22e-05 | 3.68e-05 | 2.01e-05 |
| Sodium | 9.51e-03 | 7.86e-03 | 6.28e-03 | 7.89e-03 |
| Strontium | 4.04e-03 | 4.68e-03 | 3.79e-03 | 4.17e-03 |
| Vanadium | 3.72e-04 | 3.56e-04 | 3.45e-04 | 3.58e-04 |
| Zinc | | 8.57e-04 | 5.51e-04 | 7.04e-04 |
| ^a Pages 5 and 7. | | | | |
| ^b Pollutant was not detected in any of the sampling runs. EF is based on detection limits. | | | | |
| ^c Divide emission rate by coal feed rate. | | | | |

REFERENCE 27 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 17 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: RESULTS OF THE MARCH 1990 TRACE METAL
CHARACTERIZATION STUDY ON UNIT 3 AT THE SHERBURNE
COUNTY GENERATING STATION

FACILITY: NSP SHERCO
UNIT NO.: 3
LOCATION: Becker, Minnesota
FILENAME SHERCO3A.tbl

| PROCESS DATA | | METALS | | |
|---|--|-------------|-------------|--|
| | Run 1 | Run 2 | Run 3 | |
| Oxygen (% v/v) ^a | 6.50 | 6.20 | 6.10 | |
| Vol. Flow Rate (dscf/m) ^b | 1,950,168 | 1,965,867 | 1,962,255 | |
| Vol. Flow Rate (dscf/hr) | 117,010,080 | 117,952,020 | 117,735,300 | |
| F-factor (dscf/MMBtu) ^c | 9,780 | 9,780 | 9,780 | |
| Heat input (MMBtu/hr) | 8,243 | 8,483 | 8,525 | |
| HHV Bituminous Coal (Btu/lb) ^d | 8,547 | 8,547 | 8,547 | |
| HHV Bituminous Coal (Btu/ton) | 17,094,000 | 17,094,000 | 17,094,000 | |
| Coal Feed (ton/hr) | 482 | 496 | 499 | |
| CHROME VI | | | | |
| | Run 1 | Run 2 | Run 3 | |
| Oxygen (% v/v) ^a | 6.10 | 6.10 | 6.00 | |
| Vol. Flow Rate (dscf/m) ^b | 1,957,528 | 1,950,487 | 1,944,863 | |
| Vol. Flow Rate (dscf/hr) | 117,029,220 | 116,691,780 | | |
| F-factor (dscf/MMBtu) ^c | 9,780 | 9,780 | 9,780 | |
| Heat input (MMBtu/hr) | 8,504 | 8,474 | 8,506 | |
| HHV Bituminous Coal (Btu/lb) ^d | 8,547 | 8,547 | 8,547 | |
| HHV Bituminous Coal (Btu/ton) | 17,094,000 | 17,094,000 | 17,094,000 | |
| Coal Feed (ton/hr) | 497 | 496 | 498 | |
| Coal type ^e | Subbituminous | | | |
| Boiler configuration ^e | Pulverized, dry bottom | | | |
| Coal source ^e | Montana | | | |
| SCC | 10100222 | | | |
| Control device 1 ^e | Flue Gas Desulfurization, Spray Dryer absorber | | | |
| Control device 2 ^e | Baghouse | | | |

REFERENCE 27 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 17 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| | | | | |
|--|---|--|----------|-----|
| Data Quality | B | Had to use F-factor and average HHV to get coal feed rate (ton/hr) | | |
| Process Parameters ^c | 860 megawatts, on line in 1987. | | | |
| Test methods ^f | MM5 for metals, MM13 for chrome VI. | | | |
| Number of test runs ^g | 2 for calcium, nickel, sodium and zinc. 3 for all others. | | | |
| ^a Page 12 for metals runs; page 13 for chrome VI runs. ^b Page 16 for metals runs, page 18 for chrome VI runs. ^c 40 CFR Pt 60, App A, Meth. 19, Bituminous coal. ^d From report "Results of the May 29, 1990 Trace Metal Characterization Study on Units 1 and 2 at the Sherburne County Generating Station in Becker, Minnesota", page G-1. (Reference No. 25). ^e Page 1. Assumed dry bottom. ^f Page 1 for MM5, page 2 for MM 13. ^g Various pages. | | | | |
| METALS EMISSION FACTORS | | | | |
| EMISSION RATES (lb/hr) ^a | Run 1 | Run 2 | Run 3 | AVG |
| Aluminum | 1.91 | 0.493 | 0.742 | |
| Antimony | 7.09e-03 | 1.62e-03 | 1.6e-03 | |
| Arsenic ^b | --- | 4.12e-04 | 4.12e-04 | |
| Barium ^b | 0.048 | 0.049 | 0.050 | |
| Beryllium | 1.61e-05 | 4.93e-05 | 9.92e-05 | |
| Boron | 19.1 | 3.28 | 13.9 | |
| Calcium | --- | 1.91 | 1.85 | |
| Chromium | 0.114 | 0.0682 | 0.0520 | |
| Copper | 0.789 | 0.384 | 0.188 | |
| Iron | 1.04 | 0.759 | 0.248 | |
| Lead | 0.123 | 0.0394 | 0.033 | |
| Magnesium | 0.294 | 0.123 | 0.215 | |
| Manganese | 0.0565 | 0.382 | 0.0379 | |
| Mercury | 0.0411 | 0.0172 | 0.0338 | |
| Molybdenum ^b | 0.032 | 0.033 | 0.033 | |
| Nickel | --- | 0.0736 | 0.0264 | |
| Potassium | 1.83 | 0.624 | 0.602 | |
| Selenium ^b | 0.0199 | 0.0205 | 0.0207 | |
| Silver ^b | 2.41e-03 | 2.43e-03 | 2.50e-03 | |

REFERENCE 27 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 17 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS EMISSION FACTORS | | | | |
|--|----------|----------|----------|----------|
| EMISSION RATES (lb/hr) ^a | Run 1 | Run 2 | Run 3 | AVG |
| Sodium | --- | 4.62 | 4.80 | |
| Strontium | 0.0119 | 0.0411 | 0.0412 | |
| Vanadium ^b | 8.04e-04 | 8.10e-04 | 8.09e-04 | |
| Zinc | --- | 0.262 | 0.172 | |
| EMISSION FACTORS (lb/ton) ^c | Run 1 | Run 2 | Run 3 | AVG |
| Aluminum | 3.96e-03 | 9.93e-04 | 1.49e-03 | 2.15e-03 |
| Antimony | 1.47e-05 | 3.26e-06 | 3.21e-06 | 7.06e-06 |
| Arsenic ^b | | 8.30e-07 | 8.26e-07 | 8.28e-07 |
| Barium ^b | 9.95e-05 | 9.87e-05 | 1.00e-04 | 9.95e-05 |
| Beryllium | 3.34e-08 | 9.93e-08 | 1.99e-07 | 1.11e-07 |
| Boron | 3.96e-02 | 6.61e-03 | 2.79e-02 | 2.47e-02 |
| Calcium | | 3.85e-03 | 3.71e-03 | 3.78e-03 |
| Chromium | 2.36e-04 | 1.37e-04 | 1.04e-04 | 1.59e-04 |
| Copper | 1.64e-03 | 7.74e-04 | 3.77e-04 | 9.29e-04 |
| Iron | 2.16e-03 | 1.53e-03 | 4.97e-04 | 1.39e-03 |
| Lead | 2.55e-04 | 7.94e-05 | 6.62e-05 | 1.34e-04 |
| Magnesium | 6.10e-04 | 2.48e-04 | 4.31e-04 | 4.30e-04 |
| Manganese | 1.17e-04 | 7.70e-04 | 7.60e-05 | 3.21e-04 |
| Mercury | 8.52e-05 | 3.47e-05 | 6.78e-05 | 6.26e-05 |
| Molybdenum ^b | 6.64e-05 | 6.65e-05 | 6.62e-05 | 6.63e-05 |
| Nickel | | 1.48e-04 | 5.29e-05 | 1.01e-04 |
| Potassium | 3.79e-03 | 1.26e-03 | 1.21e-03 | 2.09e-03 |
| Selenium ^b | 4.13e-05 | 4.13e-05 | 4.15e-05 | 4.14e-05 |
| Silver ^b | 5.00e-06 | 4.90e-06 | 5.01e-06 | 4.97e-06 |
| Sodium | | 9.31e-03 | 9.63e-03 | 9.47e-03 |
| Strontium | 2.47e-05 | 8.28e-05 | 8.26e-05 | 6.34e-05 |
| Vanadium ^b | 1.67e-06 | 1.63e-06 | 1.62e-06 | 1.64e-06 |
| Zinc | | 5.28e-04 | 3.45e-04 | 4.36e-04 |
| ^a Pages 5 and 7. ^b Pollutant was not detected in any of the sampling runs. EF is based on detection limits. ^c Divide emission rate by coal feed rate. | | | | |

REFERENCE 27 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 17 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| CHROME VI EMISSION FACTORS | | | | |
|--|----------|----------|----------|----------|
| | Run 1 | Run 2 | Run 3 | AVG |
| Emission Rates (lb/hr) ^a | 0.0095 | 0.0028 | 0.0100 | |
| Emission Factors (lb/ton) ^b | 1.91e-05 | 5.65e-06 | 2.01e-05 | 1.49e-05 |
| ^a Page 8. | | | | |
| ^b Divide emission rate by coal feed rate. | | | | |

REFERENCE 28 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 18 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: FIELD CHEMICAL EMISSIONS MONITORING PROJECT: SITE 10 EMISSIONS MONITORING.
RADIANT CORPORATION, AUSTIN, TEXAS. OCTOBER, 1992.

FACILITY: EPRI SITE 10
FILENAME SITE10.tbl

| PROCESS DATA | | | |
|--|---|-------------------------------------|--------|
| Coal feed rate, dry (lb/hr) ^a | 108,626 | Coal HHV, dry (Btu/lb) ^b | 11,000 |
| Coal moisture percent by weight ^b | 7.3% | Coal HHV, as received (Btu/lb) | 10,252 |
| Coal feed rate, as received (lb/hr) | 117,180 | Coal HHV, as received (MMBtu/lb) | 0.01 |
| Coal feed rate, as received (ton/hr) | 58.59 | Coal HHV, as received (MMBtu/ton) | 20.50 |
| Stack gas flow rate (dscf/hr) ^a | 15,500,000 | | |
| Coal type ^c | Subbituminous | | |
| Boiler configuration ^d | Circulating Fluidized Bed Combustor (CFBC) | | |
| Coal source ^e | Salt River | | |
| SCC | 10100238 | | |
| Control device 1 ^e | Flue gas desulfurization by limestone injection into the combustion chamber (FGD-FIL) | | |
| Control device 2 ^e | Fabric Filter | | |
| Data Quality | A | | |
| Process Parameters ^d | 110 megawatts | | |
| Test methods ^f | EPA, or EPA-approved, test methods | | |
| Number of test runs ^g | 5 for benzene, 1 for all others. | | |

REFERENCE 28 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 18 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

^aPage C-3

^bPage B-3

^cAppendix B of EPRI Synthesis Report, page B-3.

^dAppendix B of EPRI Synthesis Report, page B-6.

^ePage 1-1

^fPages A-3 through A-13

^gPage 3-1 and B-15 for benzene, page 3-1 for others.

REFERENCE 28 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 18 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS, VOC EMISSION FACTORS ^a | | | |
|--|-----------------------------|------------|-----------------------|
| Pollutant | (lb/10 ³ 12 Btu) | (lb/MMBtu) | (lb/ton) ^c |
| Arsenic ^b | 1 | 1.00e-06 | 2.05e-05 |
| Barium | 12.1 | 1.21e-05 | 2.48e-04 |
| Beryllium ^b | 0.2 | 2.00e-07 | 4.10e-06 |
| Cadmium ^b | 0.4 | 4.00e-07 | 8.20e-06 |
| Chloride | 958 | 9.58e-04 | 1.96e-02 |
| Chromium | 1.6 | 1.60e-06 | 3.28e-05 |
| Cobalt ^b | 0.8 | 8.00e-07 | 1.64e-05 |
| Copper ^b | 2 | 2.00e-06 | 4.10e-05 |
| Fluoride ^b | 18 | 1.80e-05 | 3.69e-04 |
| Lead | 0.6 | 6.00e-07 | 1.23e-05 |
| Manganese | 31 | 3.10e-05 | 6.36e-04 |
| Molybdenum ^b | 4 | 4.00e-06 | 8.20e-05 |
| Nickel ^b | 2 | 2.00e-06 | 4.10e-05 |
| Phosphorous ^b | 24 | 2.40e-05 | 4.92e-04 |
| Selenium ^b | 16 | 1.60e-05 | 3.28e-04 |
| Vanadium ^b | 2 | 2.00e-06 | 4.10e-05 |
| Formaldehyde ^b | 15 | 1.50e-05 | 3.08e-04 |
| Benzene | 2 | 2.00e-06 | 4.10e-05 |
| ^a Page 3-12 | | | |
| ^b Emission factor is based only on detection limits. | | | |
| ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 28 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 18 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| MISC. EMISSION FACTORS | | | | | |
|--|--|---|---|---------------------------------------|--|
| Pollutant | Stack Gas Conc. (ug/Nm3) ^a | Stack Gas Conc. (ug/dscm) ^b | Stack Gas Conc. (lb/dscf) ^c | Emission Rate (lb/hr) ^d | Emission Factor (lb/ton) ^e |
| Dibutyl Phthalate | 3.1 | 2.89 | 1.80e-10 | 2.80e-03 | 4.77e-05 |
| bis(2-Ethylhexyl) phthalate | 6.0 | 5.59 | 3.49e-10 | 5.41e-03 | 9.24e-05 |
| N-Nitrosodiethylamine | 15 | 13.98 | 8.73e-10 | 1.35e-02 | 2.31e-04 |
| ^a Page 3-14 ^b Convert Normal meter to standard meter, i.e., multiply by 273/293. ^c Convert ug/dscm to lb/dscf. ^d Multiply concentration by stack gas flow rate. ^e Divide emission rate by coal feed rate. | | | | | |

REFERENCE 29 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 19 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: FIELD CHEMICAL EMISSIONS MONITORING PROJECT: SITE 11 EMISSIONS MONITORING.
RADIANT CORPORATION, AUSTIN, TEXAS. OCTOBER, 1992.

FACILITY: EPRI SITE 11
FILENAME SITE11.tb1

| PROCESS DATA | |
|---|---|
| Coal type ^a | Subbituminous |
| Boiler configuration ^b | Pulverized, dry, tangential |
| Coal source ^a | Powder River Basin |
| SCC | 10100226 |
| Control device 1 ^a | Over Fire Air |
| Control device 2 ^a | ESP |
| Control device 3 ^a | Flue Gas Desulfurization, Wet Limestone Scrubber (Absorber) |
| Data Quality | B |
| Process Parameters ^a | 700 MW |
| Test methods ^c | EPA, or EPA-approved, test methods |
| Number of test runs ^d | 1 |
| Stack gas flow rate (dscf/m) ^e | 1,598,400 |
| Stack gas flow rate (dscf/hr) | 95,904,000 |
| Stack Gas O ₂ % ^e | 6.9 |
| F-factor (dscf/MMBtu) ^f | 9,780 |
| Heat input (MMBtu/hr) | 6568.7 |
| Coal HHV, as received (Btu/lb) ^a | 8,300 |
| Coal HHV, as received (MMBtu/lb) | 0.008 |
| Coal HHV, as received (MMBtu/ton) | 16.60 |

REFERENCE 29 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 19 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| Coal feed rate as received (ton/hr) | | 395.70 | | | | | |
|---|---|-----------------------------------|----------------|-----------------|-----------------|------------------------------------|---------------------------------------|
| ^a Page 2-1. | | | | | | | |
| ^b Page 2-1. Assumed dry bottom. | | | | | | | |
| ^c Appendix A. | | | | | | | |
| ^d Page 3-18. | | | | | | | |
| ^e Page D-7. | | | | | | | |
| ^f 40 CFR Pt 60, App. A, Meth. 19, bituminous coal. | | | | | | | |
| METALS, VOC EMISSION FACTORS | | | | | | | |
| Pollutant | Particulate Phase (ug/Nm3) ^a | Vapor Phase (ug/Nm3) ^a | Total (ug/Nm3) | Total (ug/dscm) | Total (lb/dscf) | Emission Rate (lb/hr) ^c | Emission Factor (lb/ton) ^d |
| Arsenic | 1.0 | NR(3) | 1.0 | 0.93 | 5.82e-11 | 5.58e-03 | 1.41e-05 |
| Barium | 97 | NR(6) | 97.0 | 90.38 | 5.64e-09 | 5.41e-01 | 1.37e-03 |
| Beryllium ^b | NR(0.2) | NR(1) | 0.20 | 0.19 | 1.16e-11 | 1.12e-03 | 2.82e-06 |
| Cadmium | | 1.3 | 1.3 | 1.21 | 7.56e-11 | 7.25e-03 | 1.83e-05 |
| Chlorine | | 2200 | 2,200 | 2049.83 | 1.28e-07 | 1.23e+01 | 3.10e-02 |
| Chromium | 7.0 | NR(6) | 7.0 | 6.52 | 4.07e-10 | 3.91e-02 | 9.87e-05 |
| Cobalt | 1.7 | NR(6) | 1.7 | 1.58 | 9.89e-11 | 9.49e-03 | 2.40e-05 |
| Copper | 2.1 | NR(10) | 2.1 | 1.96 | 1.22e-10 | 1.17e-02 | 2.96e-05 |
| Fluorine | | 130 | 130.00 | 121.13 | 7.56e-09 | 7.25e-01 | 1.83e-03 |
| Lead | | 14 | 14.00 | 13.04 | 8.15e-10 | 7.81e-02 | 1.97e-04 |
| Manganese | 3.9 | 110 | 113.90 | 106.13 | 6.63e-09 | 6.36e-01 | 1.61e-03 |
| Mercury | 0.016 | 3.7 | 3.72 | 3.46 | 2.16e-10 | 2.07e-02 | 5.24e-05 |
| Molybdenum ^b | NR(5) | NR(30) | 5 | 4.66 | 2.91e-10 | 2.79e-02 | 7.05e-05 |
| Nickel | 4.7 | NR(10) | 4.7 | 4.38 | 2.73e-10 | 2.62e-02 | 6.63e-05 |

REFERENCE 29 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 19 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| | | | | | | |
|--------------------------|--------|----|-------|----------|----------|----------|
| Phosphorous ^b | NR(20) | 20 | 18.63 | 1.16e-09 | 1.12e-01 | 2.82e-04 |
|--------------------------|--------|----|-------|----------|----------|----------|

REFERENCE 29 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 19 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS, VOC EMISSION FACTORS | | | | | | |
|---------------------------------------|---|---|-------------------|--------------------|--------------------|--|
| Pollutant | Particulate Phase (ug/Nm3) ^a | Vapor Phase (ug/Nm3) ^a | Total (ug/Nm3) | Total (ug/dscm) | Total (lb/dscf) | Emission Rate (lb/hr) ^c |
| Selenium ^b | | NR(3) | 3 | 2.80 | 1.75e-10 | 1.67e-02 |
| Vanadium | 2.6 | NR(10) | 2.6 | 2.42 | 1.51e-10 | 1.45e-02 |
| Formaldehyde ^b | | NR(10) | 10 | 9.32 | 5.82e-10 | 5.58e-02 |
| Naphthalene ^b | NR(4) | | 4 | 3.73 | 2.33e-10 | 2.23e-02 |
| Emission Factor (lb/ton) ^d | | | | | | |
| Selenium ^b | | | | | | 4.23e-05 |
| Vanadium | | | | | | 3.67e-05 |
| Formaldehyde ^b | | | | | | 1.41e-04 |
| Naphthalene ^b | | | | | | 5.64e-05 |

^aPage 3-18, Run 2 data only (other runs invalid).

^bPage 3-18. Detection limit value for one run used in calculating EF.

^cMultiply concentration by stack gas flow rate.

^dDivide emission rate by coal feed rate.

REFERENCE 30 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 20 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: FIELD CHEMICAL EMISSIONS MONITORING PROJECT: SITE
12 EMISSIONS MONITORING. RADIAN CORPORATION,
AUSTIN, TEXAS. NOVEMBER, 1992.

FACILITY: EPRI SITE 12
FILENAME SITE12.tbl

PROCESS DATA

| | |
|-------------------------------------|--|
| Coal type ^a | Bituminous |
| Boiler configuration ^b | Pulverized, dry, opposed |
| Coal source ^a | West Pa. |
| SCC | 10100202 |
| Control device 1 ^c | ESP |
| Control device 2 ^c | Flue Gas Desulfurization, Wet Limestone Scrubber (Absorber) |
| Control device 3 | None |
| Data Quality | A |
| Process Parameters ^c | 700 MW |
| Test methods ^d | EPA, or EPA-approved, test methods |
| Number of test runs ^e | 2 for Metals, 3 for VOCs. |
| Coal HHV, dry (Btu/lb) ^f | 13,733 |
| Coal moisture % ^f | 4.12% |
| Coal HHV, as received (Btu/lb) | 13,190 |
| Coal HHV, as received (Btu/ton) | 26,379,178 |
| Coal HHV, as received (MMBtu/ton) | 26.4 |

^aPage 3-5.

^bPage 2-1. Assumed dry bottom.

^cPage 2-1.

^dAppendix A.

^ePage 3-11 for PM/metals, Page 3-14 for VOC.

^fPage 3-6.

REFERENCE 30 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 20 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS, VOC EMISSION FACTORS ^a | | | |
|--|--|-------------------------------|--|
| Pollutant | Emission Factor (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor (lb/ton) ^c |
| Arsenic | 0.45 | 4.50e-07 | 1.19e-05 |
| Barium | 6.3 | 6.30e-06 | 1.66e-04 |
| Beryllium ^b | 0.16 | 1.60e-07 | 4.22e-06 |
| Cadmium | 1.2 | 1.20e-06 | 3.17e-05 |
| Chloride | 2500 | 2.50e-03 | 6.59e-02 |
| Chromium | 3.5 | 3.50e-06 | 9.23e-05 |
| Cobalt ^b | 1.0 | 1.00e-06 | 2.64e-05 |
| Copper | 4.4 | 4.40e-06 | 1.16e-04 |
| Fluoride | 27 | 2.70e-05 | 7.12e-04 |
| Lead | 5.7 | 5.70e-06 | 1.50e-04 |
| Manganese | 1.6 | 1.60e-06 | 4.22e-05 |
| Mercury | 0.16 | 1.60e-07 | 4.22e-06 |
| Molybdenum | 4 | 4.00e-06 | 1.06e-04 |
| Nickel | 4.4 | 4.40e-06 | 1.16e-04 |
| Selenium | 13 | 1.30e-05 | 3.43e-04 |
| Vanadium ^b | 1.6 | 1.60e-06 | 4.22e-05 |
| Formaldehyde ^b | 8.4 | 8.40e-06 | 2.22e-04 |
| Bromomethane ^b | 0.43 | 4.30e-07 | 1.13e-05 |
| 1,1,1-trichloroethane | 0.75 | 7.50e-07 | 1.98e-05 |
| Benzene | 0.69 | 6.90e-07 | 1.82e-05 |
| Toluene | 1.04 | 1.04e-06 | 2.74e-05 |
| m,p-xylene | 0.72 | 7.20e-07 | 1.90e-05 |
| ^a Page 3-12 for metals, page 3-14 for VOC. See page 3-11 for number of non-detect runs for pm/metals. | | | |
| ^b Detection limit value for two runs used in calculating EF. | | | |
| ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 31 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 21 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: FIELD CHEMICAL EMISSIONS MONITORING PROJECT:
SITE 15 EMISSIONS MONITORING. RADIAN CORPORATION,
AUSTIN, TEXAS. OCTOBER, 1992.

FACILITY: EPRI SITE 15
FILENAME SITE15.tbl

PROCESS DATA

| | |
|-------------------------------------|------------------------------------|
| Coal type ^a | Bituminous |
| Boiler configuration ^b | Pulverized, dry, tangential |
| Coal source ^a | Eastern US |
| SCC | 10100212 |
| Control device 1 ^a | ESP cold side |
| Control device 2 | None |
| Control device 3 | None |
| Data Quality | A |
| Process Parameters ^a | 600 MW |
| Test methods ^c | EPA, or EPA-approved, test methods |
| Number of test runs ^d | 2 for lead, 3 for all others |
| Coal HHV, dry (Btu/lb) ^e | 13,000 |
| Coal HHV, as received (Btu/ton) | 26,000,000 |
| Coal HHV, as received (MMBtu/ton) | 26.0 |

^aPage 2-1.

^bPage 2-1. Assumed dry bottom.

^cAppendix A.

^dPage 3-9.

^ePage 3-4, assumed to be as fired.

REFERENCE 31 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 21 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| EMISSION FACTORS ^a | | | |
|---|--|-------------------------------|--|
| Pollutant | Emission Factor (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor (lb/ton) ^c |
| Arsenic | 13 | 1.30e-05 | 3.38e-04 |
| Barium | 34 | 3.40e-05 | 8.84e-04 |
| Beryllium | 0.4 | 4.00e-07 | 1.04e-05 |
| Cadmium | 3.1 | 3.10e-06 | 8.06e-05 |
| Chloride | 46,700 | 4.67e-02 | 1.21e+00 |
| Chromium | 12 | 1.20e-05 | 3.12e-04 |
| Cobalt | 2.0 | 2.00e-06 | 5.20e-05 |
| Copper | 5.5 | 5.50e-06 | 1.43e-04 |
| Fluoride | 3,850 | 3.85e-03 | 1.00e-01 |
| Lead | 4.3 | 4.30e-06 | 1.12e-04 |
| Manganese | 8.6 | 8.60e-06 | 2.24e-04 |
| Molybdenum | 5.3 | 5.30e-06 | 1.38e-04 |
| Nickel | 5.9 | 5.90e-06 | 1.53e-04 |
| Selenium | 77 | 7.70e-05 | 2.00e-03 |
| Vanadium | 14 | 1.40e-05 | 3.64e-04 |
| Benzene | 0.8 | 8.00e-07 | 2.08e-05 |
| Formaldehyde ^b | 5 | 5.00e-06 | 1.30e-04 |
| Toluene | 5.2 | 5.20e-06 | 1.35e-04 |
| ^a Page 3-10. ^b Emission factors is based only on detection limits. ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 32 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 22 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: FIELD CHEMICAL EMISSIONS MONITORING PROJECT: SITE 19 EMISSIONS MONITORING.
RADIANT CORPORATION, AUSTIN, TEXAS. NOVEMBER, 1992.

FACILITY: EPRI SITE 19
FILENAME SITE19.tbl

| PROCESS DATA | | | |
|-----------------------------------|------------------------------------|--|------------|
| Coal type ^a | Bituminous | Coal HHV, dry (Btu/lb) ^g | 13,467 |
| Boiler configuration ^b | Pulverized, dry, opposed | Coal moisture % ^g | 6.1 % |
| Coal source | Virginia, Kentucky | Coal HHV, as received (Btu/lb) | 12,693 |
| SCC | 10100202 | Coal HHV, as received (Btu/ton) | 25,385,485 |
| Control device 1 ^c | ESP cold side | Coal HHV, as received (MMBtu/ton) | 25.4 |
| Control device 2 | None | Coal feed rate, dry (lb/hr) ^b | 694,000 |
| Control device 3 | None | Coal moisture percent by weight ^g | 6.1 % |
| Data Quality | A | Coal feed rate, as received (lb/hr) | 739,084 |
| Process Parameters ^d | 1160 MW | Coal feed rate, as received (ton/hr) | 369.54 |
| Test methods ^e | EPA, or EPA-approved, test methods | Stack gas flow rate (Nm ³ /hr) ^h | 4,000,000 |
| Number of test runs ^f | 3 | | |

^aPage 2-1.

^bPage 2-1. Assumed dry bottom.

^cPage 2-1.

^dPage 2-2.

^eAppendix A.

^fPage 3-7.

^gPage 3-5.

^hPage 3-8.

REFERENCE 32 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 22 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS | | | |
|--|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor (lb/ton) ^b |
| Arsenic | 7.9 | 7.90e-06 | 2.01e-04 |
| Cadmium | 0.13 | 1.30e-07 | 3.30e-06 |
| Chloride | 75,000 | 7.50e-02 | 1.90e+0 |
| Chromium | 13 | 1.30e-05 | 3.30e-04 |
| Copper | 12 | 1.20e-05 | 3.05e-04 |
| Fluoride | 5,800 | 5.80e-03 | 1.47e-01 |
| Manganese | 5.4 | 5.40e-06 | 1.37e-04 |
| Mercury | 6.2 | 6.20e-06 | 1.57e-04 |
| Nickel | 7.9 | 7.90e-06 | 2.01e-04 |
| Selenium | 260 | 2.60e-04 | 6.60e-03 |
| ^a Page 3-8. | | | |
| ^b Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 32 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 22 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| MISCELLANEOUS EMISSION FACTORS | | | | | | | | | | | |
|---|----------------------|---------------|---------------|-----------------------|-------------------|-------|-------|-------|-------------|-------|-------|
| Pollutant Concentration (ug/Nm3) ^a | Solid Phase Conc. | | | | Vapor Phase Conc. | | | | Total conc. | | |
| | Run 2 | Run 3 | Run 4 | Run 4 | Run 2 | Run 3 | Run 4 | Run 4 | Run 2 | Run 3 | Run 4 |
| Antimony | 0.47 | 0.39 | 0.35 | 0.35 | 0.76 | 1.9 | 1.7 | 1.7 | 0.47 | 2.29 | 2.05 |
| Beryllium | 1.1 | 1.0 | 0.72 | 0.72 | 0.49 | 0.55 | 0.50 | 0.50 | 1.1 | 1.55 | 1.22 |
| Cobalt | 4.3 | 4.2 | 2.8 | 2.8 | 2.5 | 2.8 | 2.5 | 2.5 | 4.3 | 7 | 5.3 |
| | emission rate | emission rate | emission rate | emission factor | | | | | | | |
| Pollutant emissions | (ug/hr) ^b | (lb/hr) | (lb/hr) | (lb/ton) ^c | | | | | | | |
| Antimony | 6,413,333 | 1.41e-02 | 3.83e-05 | | | | | | | | |
| Beryllium | 5,160,000 | 1.14e-02 | 3.08e-05 | | | | | | | | |
| Cobalt | 22,133,333 | 4.88e-02 | 1.32e-04 | | | | | | | | |
| ^a Page 3-9. | | | | | | | | | | | |
| ^b Multiply concentration by stack gas flow rate. | | | | | | | | | | | |
| ^c Divide emission rate by coal feed rate. | | | | | | | | | | | |

REFERENCE 33 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 23 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: FIELD CHEMICAL EMISSIONS MONITORING PROJECT:
SITE 20 EMISSIONS MONITORING RADIAN CORPORATION,
AUSTIN, TEXAS. MARCH, 1994.

FACILITY: EPRI SITE 20
FILENAME SITE20.tbl

PROCESS DATA

| | |
|---|--|
| Coal type ^a | Lignite |
| Boiler configuration ^b | Pulverized |
| Coal source ^f | Wilcox, Texas |
| SCC | 10100301 |
| Control device 1 ^a | ESP cold side |
| Control device 2 ^a | Flue Gas Desulfurization- Wet Limestone Scrubber (absorber) |
| Control device 3 | None |
| Data Quality | A |
| Process Parameters ^a | 680 MW |
| Test methods ^c | EPA, or EPA-approved, test methods |
| Number of test runs ^d | 4 |
| Coal HHV, as received (Btu/lb) ^e | 6,760 |
| Coal HHV, as received (Btu/ton) | 13,520,000 |
| Coal HHV, as received (MMBtu/ton) | 13.5 |

^aPage 2-1.

^bPage 2-5.

^cAppendix A.

^dPage 3-9.

^ePage 2-2.

^fAppendix B of EPRI Synthesis Report, page B-3.

REFERENCE 33 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 23 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| EMISSION FACTORS | Emission Factor ^a | Emission Factor | Emission Factor |
|------------------|---------------------------------|--------------------|-----------------------|
| Pollutant | (lb/10 ¹² Btu) | (lb/MMBtu) | (lb/ton) ^b |
| Arsenic | 0.63 | 6.30e-07 | 8.52e-06 |
| Barium | 42 | 4.20e-05 | 5.68e-04 |
| Beryllium | 0.35 | 3.50e-07 | 4.73e-06 |
| Cadmium | 0.70 | 7.00e-07 | 9.46e-06 |
| Chloride | 390 | 3.90e-04 | 5.27e-03 |
| Chromium | 2.8 | 2.80e-06 | 3.79e-05 |

REFERENCE 33 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 23 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| EMISSION FACTORS | | Emission Factor ^a | Emission Factor | Emission Factor |
|---|---------------------------|------------------------------|-----------------------|-----------------|
| Pollutant | (lb/10 ¹² Btu) | (lb/MMBtu) | (lb/ton) ^b | |
| Cobalt | 0.69 | 6.90e-07 | 9.33e-06 | |
| Fluoride | 430 | 4.30e-04 | 5.81e-03 | |
| Lead | 3.8 | 3.80e-06 | 5.14e-05 | |
| Manganese | 8.5 | 8.50e-06 | 1.15e-04 | |
| Mercury | 12 | 1.20e-05 | 1.62e-04 | |
| Nickel | 4.3 | 4.30e-06 | 5.81e-05 | |
| Phosphorous | 21 | 2.10e-05 | 2.84e-04 | |
| Selenium | 160 | 1.60e-04 | 2.16e-03 | |
| Vanadium | 3.08 | 3.08e-06 | 4.16e-05 | |
| ^a Page 3-11, Stack data. | | | | |
| ^b Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | | |
| Antimony EMISSION FACTOR: Note that antimony was not detected in any of the sampling runs. | | | | |
| | Run 1 | Run 2 | Run 3 | Run 4 |
| Coal feed rate (lb/hr, dry) ^a | 630,000 | 614,000 | 619,000 | 618,000 |
| Coal moisture (%) ^a | 33.5% | 34.2% | 33.6% | 34.4% |
| Coal feed rate (lb/hr, wet) (as fired) | 947,368 | 933,131 | 932,229 | 942,073 |
| Coal feed rate (ton/hr) | 474 | 467 | 466 | 471 |
| Stack gas flow rate (Nm ³ /hr) ^b | 3,100,000 | 3,140,000 | 3,100,000 | 3,040,000 |
| Antimony concentration (ug/Nm ³) ^{b,c} | 1.31 | 1.07 | 1.13 | 1.29 |
| Antimony emission rate (ug/hr) ^d | 4,061,000 | 3,359,800 | 3,503,000 | 3,921,600 |
| Antimony emission rate (lb/hr) ^e | 8.95e-03 | 7.41e-03 | 7.72e-03 | 8.65e-03 |
| Antimony emission factor (lb/ton) ^f | 1.89e-05 | 1.59e-05 | 1.66e-05 | 1.84e-05 |
| | | | avg | |
| | | | 1.74e-05 | |
| ^a Page 3-6. | | | | |
| ^b Page 3-9. | | | | |
| ^c Pollutant was not detected in any sampling runs. EF based on detection limits. | | | | |
| ^d Multiply concentration by stack gas flow rate. | | | | |
| ^e Convert ug/hr to lb/hr. | | | | |
| ^f Divide emission rate by coal feed rate. | | | | |

REFERENCE 34 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 24 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: FIELD CHEMICAL EMISSIONS MONITORING PROJECT:
SITE 21 EMISSIONS MONITORING. RADIAN CORPORATION,
AUSTIN, TEXAS. AUGUST, 1993.

FACILITY: EPRI SITE 21
FILENAME SITE21.tbl

PROCESS DATA

| | |
|-------------------------------------|---|
| Coal type ^a | Bituminous |
| Boiler configuration ^b | Pulverized, dry, opposed |
| Coal source ^a | Pa., W. Va. |
| SCC | 10100202 |
| Control device 1 ^c | ESP |
| Control device 2 ^c | Flue Gas Desulfurization, Wet Limestone Scrubber (Absorber) |
| Control device 3 | None |
| Data Quality | A |
| Process Parameters ^c | 667 MW |
| Test methods ^d | EPA, or EPA-approved, test methods |
| Number of test runs ^e | 8 for PM/metals, 7 for semi-volatiles |
| Coal HHV, dry (Btu/lb) ^f | 14,032 |
| Coal moisture % ^g | 7% |
| Coal HHV, as received (Btu/lb) | 13,114 |
| Coal HHV, as received (Btu/ton) | 26,228,037 |
| Coal HHV, as received (MMBtu/ton) | 26.2 |

^aPage 3-6.

^bAssumed to be pulverized, dry bottom.

^cPage 2-3.

^dAppendix A.

^ePage 3-10 for metals, page 3-14 for semi-volatiles.

^fPage 3-5.

^gPage 7-2.

| EMISSION FACTORS | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^b (lb/ton) |
|------------------|---|-------------------------------|--|
| Pollutant | | | |
| Acenaphthene | 0.018 | 1.80e-08 | 4.72e-07 |
| Acenaphthylene | 0.0075 | 7.50e-09 | 1.97e-07 |
| Anthracene | 0.0099 | 9.90e-09 | 2.60e-07 |
| Arsenic | 6.17 | 6.17e-06 | 1.62e-04 |

REFERENCE 34 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 24 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| EMISSION FACTORS | Emission Factor ^a | Emission Factor | Emission Factor ^b |
|--|------------------------------|-----------------|------------------------------|
| Pollutant | (lb/10 ⁶ Btu) | (lb/MMBtu) | (lb/ton) |
| Barium | 3.21 | 3.21e-06 | 8.42e-05 |
| Benz(a)anthracene | 0.0013 | 1.30e-09 | 3.41e-08 |
| Benzo(a)pyrene | 0.0018 | 1.80e-09 | 4.72e-08 |
| Benzo(b,j,k)fluoranthenes | 0.0066 | 6.60e-09 | 1.73e-07 |
| Benzo(g,h,i)perylene | 0.0012 | 1.20e-09 | 3.15e-08 |
| Beryllium | 0.13 | 1.30e-07 | 3.41e-06 |
| Cadmium | 0.57 | 5.70e-07 | 1.49e-05 |
| Chloride | 1,980 | 1.98e-03 | 5.19e-02 |
| Chromium | 2.74 | 2.74e-06 | 7.19e-05 |
| Chrysene | 0.0069 | 6.90e-09 | 1.81e-07 |
| Cobalt | 4.1 | 4.10e-06 | 1.08e-04 |
| Copper | 1.57 | 1.57e-06 | 4.12e-05 |
| Fluoranthene | 0.053 | 5.30e-08 | 1.39e-06 |
| Fluorene | 0.064 | 6.40e-08 | 1.68e-06 |
| Fluoride | 31.9 | 3.19e-05 | 8.37e-04 |
| Indeno(1,2,3-cd)pyrene | 0.0015 | 1.50e-09 | 3.93e-08 |
| Lead | 6.32 | 6.32e-06 | 1.66e-04 |
| Manganese | 15 | 1.50e-05 | 3.93e-04 |
| Mercury | 0.84 | 8.40e-07 | 2.20e-05 |
| Molybdenum | 0.61 | 6.10e-07 | 1.60e-05 |
| Nickel | 1.68 | 1.68e-06 | 4.41e-05 |
| Phenanthrene | 0.21 | 2.10e-07 | 5.51e-06 |
| Pyrene | 0.024 | 2.40e-08 | 6.29e-07 |
| Selenium | 9.9 | 9.90e-06 | 2.60e-04 |
| Vanadium | 5.50 | 5.50e-06 | 1.44e-04 |
| 5-Methyl Chrysene | 0.0015 | 1.50e-09 | 3.93e-08 |
| ^a Page 3-15. | | | |
| ^b Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 35 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 25 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: FIELD CHEMICAL EMISSIONS MONITORING PROJECT:
SITE 22 EMISSIONS REPORT. RADIAN CORPORATION,
AUSTIN, TEXAS. FEBRUARY, 1994.

FACILITY: EPRI SITE 22
FILENAME SITE22.tbl

PROCESS DATA

| | |
|-------------------------------------|------------------------------------|
| Coal type ^a | Subbituminous |
| Boiler configuration ^b | Pulverized, dry, opposed |
| Coal source ^a | Powder River |
| SCC | 10100222 |
| Control device 1 ^a | ESP Cold Side |
| Control device 2 | None |
| Control device 3 | None |
| Data Quality | A |
| Process Parameters ^c | 700 MW |
| Test methods ^d | EPA, or EPA-approved, test methods |
| Number of test runs ^e | 3 |
| Coal HHV, dry (Btu/lb) ^f | 11,981 |
| Coal moisture % ^f | 29.5% |
| Coal HHV, as received (Btu/lb) | 9,252 |
| Coal HHV, as received (Btu/ton) | 18,503,475 |
| Coal HHV, as received (MMBtu/ton) | 18.5 |

^aPage 2-1

^bAssumed pulverized, dry bottom.

^cPage 2-2.

^dAppendix A

^ePages 3-7 through 3-11

^fPage 3-6

REFERENCE 35 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 25 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS, ORGANIC EMISSION FACTORS | | | |
|--|--|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ⁶ Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Arsenic | 0.087 | 8.70e-08 | 1.61e-06 |
| Barium | 16 | 1.60e-05 | 2.96e-04 |
| Beryllium ^b | 0.031 | 3.10e-08 | 5.74e-07 |
| Cadmium | 0.16 | 1.60e-07 | 2.96e-06 |
| Chloride | 726 | 7.26e-04 | 1.34e-02 |
| Chromium | 0.53 | 5.30e-07 | 9.81e-06 |
| Cobalt ^b | 0.70 | 7.00e-07 | 1.30e-05 |
| Copper | 1.0 | 1.00e-06 | 1.85e-05 |
| Fluoride | 855 | 8.55e-04 | 1.58e-02 |
| Lead | 0.11 | 1.10e-07 | 2.04e-06 |
| Manganese | 1.1 | 1.10e-06 | 2.04e-05 |
| Mercury | 3.8 | 3.80e-06 | 7.03e-05 |
| Molybdenum | 1.9 | 1.90e-06 | 3.52e-05 |
| Nickel | 0.64 | 6.40e-07 | 1.18e-05 |
| Phosphorous | 11 | 1.10e-05 | 2.04e-04 |
| Selenium | 0.053 | 5.30e-08 | 9.81e-07 |
| Vanadium | 0.78 | 7.80e-07 | 1.44e-05 |
| Aluminum | 136 | 1.36e-04 | 2.52e-03 |
| Antimony ^b | 3.8 | 3.80e-06 | 7.03e-05 |
| Calcium | 325 | 3.25e-04 | 6.01e-03 |
| Iron | 52 | 5.20e-05 | 9.62e-04 |
| Magnesium | 47 | 4.70e-05 | 8.70e-04 |
| Potassium ^b | 82 | 8.20e-05 | 1.52e-03 |
| Sodium | 86 | 8.60e-05 | 1.59e-03 |
| Titanium | 12 | 1.20e-05 | 2.22e-04 |
| ^a Page 3-12. | | | |
| ^b Emission factor is based only on detection limits. | | | |
| ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 35 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 25 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| PAH EMISSION FACTORS | | | |
|---|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Acenaphthalene | 0.0034 | 3.40e-09 | 6.29e-08 |
| Acenaphthene | 0.0060 | 6.00e-09 | 1.11e-07 |
| Anthracene | 0.0046 | 4.60e-09 | 8.51e-08 |
| Benzo(a)pyrene | 0.0011 | 1.10e-09 | 2.04e-08 |
| Benzo(b,j,k)fluoranthenes | 0.0027 | 2.70e-09 | 5.00e-08 |
| Benzo(g,h,i)perylene | 0.0022 | 2.20e-09 | 4.07e-08 |
| Benz(a)anthracene | 0.0010 | 1.00e-09 | 1.85e-08 |
| Chrysene | 0.0025 | 2.50e-09 | 4.63e-08 |
| Fluoranthene | 0.024 | 2.40e-08 | 4.44e-07 |
| Fluorene | 0.012 | 1.20e-08 | 2.22e-07 |
| Indeno(1,2,3-cd)pyrene | 0.0086 | 8.60e-09 | 1.59e-07 |
| 5-Methyl Chrysene ^b | 0.00047 | 4.70e-10 | 8.70e-09 |
| Phenanthrene | 0.069 | 6.90e-08 | 1.28e-06 |
| Pyrene | 0.016 | 1.60e-08 | 2.96e-07 |
| ^a Page 3-14.. | | | |
| ^b Emission factor is based only on detection limits. | | | |
| ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu, ton. | | | |
| DIOXIN/FURAN EMISSION FACTORS | | | |
| Pollutant | Emission Factor (lb/10 ¹² Btu) ^a | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| 2,3,7,8-TCDD ^b | 3.3e-06 | 3.3e-12 | 6.1e-11 |
| Total TCDD | 4.7e-06 | 4.7e-12 | 8.7e-11 |
| Total PeCDD | ND | ND | ND |
| Total HxCDD | ND | ND | ND |
| Total HpCDD | 9.8e-06 | 9.8e-12 | 1.8e-10 |
| OCDD | 5.2e-05 | 5.2e-11 | 9.6e-10 |

REFERENCE 35 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 25 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| DIOXIN/FURAN EMISSION FACTORS | | | |
|---|---|-------------------------------|--|
| Pollutant | Emission Factor (lb/10 ¹² Btu) ^a | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| 2,3,7,8-TCDF ^b | 3.6e-06 | 3.6e-12 | 6.7e-11 |
| Total TCDF | 6.2e-06 | 6.2e-12 | 1.1e-10 |
| Total PeCDF | 7.3e-06 | 7.3e-12 | 1.4e-10 |
| Total HxCDF | 3.5e-06 | 3.5e-12 | 6.5e-11 |
| Total HpCDF | 2.2e-06 | 2.2e-12 | 4.1e-11 |
| OCDF | 4.2e-06 | 4.2e-12 | 7.8e-11 |
| ^a Page 3-15. ^b Emission factor is based only on detection limits. ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu, ton. | | | |

REFERENCE 36 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 26 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: FIELD CHEMICAL EMISSIONS MONITORING PROJECT:
SITE 101 EMISSIONS REPORT. RADIAN CORPORATION,
AUSTIN, TEXAS. OCTOBER, 1994.

FACILITY: EPRI SITE 101
FILENAME SITE101.tbl

| | |
|---|--|
| PROCESS DATA | |
| Coal type ^a | Subbituminous |
| Boiler configuration ^b | Pulverized, dry, wall-fired |
| Coal source ^c | New Mexico |
| SCC | 10100222 |
| Control device 1 ^a | Low Nox Burners (LNB) |
| Control device 2 ^a | Fabric Filter |
| Control device 3 ^a | Flue Gas Desulfurization- Wet Limestone Scrubber |
| Data Quality | A |
| Process Parameters ^a | 800 MW |
| Test methods ^d | EPA, or EPA-approved, test methods |
| Number of test runs ^e | 3 for benzene, toluene, chloride and fluoride; 2 for all others. |
| Coal HHV, dry (Btu/lb) ^f | 10,190 |
| Coal moisture % ^f | 14% |
| Coal HHV, as received (Btu/lb) | 8,939 |
| Coal HHV, as received (Btu/ton) | 17,877,193 |
| Coal HHV, as received (MMBtu/ton) | 17.9 |
| ^a Page 2-1. ^b Page 2-1, assumed dry bottom. ^c Appendix B of the EPRI Synthesis Report, page B-3. ^d Appendix A. ^e Page 3-10 for benzene and toluene, page 3-6 for others. ^f Page 3-5. | |

REFERENCE 36 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 26 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS, ORGANIC EMISSION FACTORS | | | |
|--|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^b (lb/ton) |
| Arsenic | 0.34 | 3.40e-07 | 6.08e-06 |
| Barium | 18 | 1.80e-05 | 3.22e-04 |
| Beryllium | 0.036 | 3.60e-08 | 6.44e-07 |
| Cadmium | 0.40 | 4.00e-07 | 7.15e-06 |
| Chloride | 2,500 | 2.50e-03 | 4.47e-02 |
| Chromium | 2.2 | 2.20e-06 | 3.93e-05 |
| Cobalt | 0.13 | 1.30e-07 | 2.32e-06 |
| Copper | 2.2 | 2.20e-06 | 3.93e-05 |
| Fluoride | 3,600 | 3.60e-03 | 6.44e-02 |
| Lead | 0.72 | 7.20e-07 | 1.29e-05 |
| Manganese | 10 | 1.00e-05 | 1.79e-04 |
| Mercury | 1.9 | 1.90e-06 | 3.40e-05 |
| Molybdenum | 2.6 | 2.60e-06 | 4.65e-05 |
| Nickel | 2.8 | 2.80e-06 | 5.01e-05 |
| Phosphorous | 9.2 | 9.20e-06 | 1.64e-04 |
| Selenium | 1.4 | 1.40e-06 | 2.50e-05 |
| Vanadium | 0.93 | 9.30e-07 | 1.66e-05 |
| Benzene | 0.57 | 5.70e-07 | 1.02e-05 |
| Toluene | 0.57 | 5.70e-07 | 1.02e-05 |
| ^a Page 3-13. | | | |
| ^b Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 37 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 27 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: FIELD CHEMICAL EMISSIONS MONITORING PROJECT:
SITE 111 EMISSIONS REPORT. RADIAN CORPORATION,
AUSTIN, TEXAS. MAY, 1993.

FACILITY: EPRI SITE 111
FILENAME SITE111.tbl

PROCESS DATA

| | |
|---|--|
| Coal type ^a | Subbituminous |
| Boiler configuration ^b | Pulverized, dry bottom |
| Coal source ^c | Western |
| SCC | 10100222 |
| Control device 1 ^c | Low Nox Burners (LNB) |
| Control device 2 ^c | Flue Gas Desulfurization- Spray Dryer (FGD-SD) |
| Control device 3 ^c | Fabric Filter (FF) |
| Data Quality | A |
| Process Parameters ^c | 267 MW |
| Test methods ^d | EPA, or EPA-approved, test methods |
| Number of test runs ^e | 2 |
| Coal HHV, as fired (received) (Btu/lb) ^f | 10,020 |
| Coal HHV, as fired (received) (Btu/ton) | 20,040,000 |
| Coal HHV, as fired (received) (MMBtu/ton) | 20.0 |

^aPage 2-2.

^bAssumed dry bottom.

^cPage 2-1.

^dPage 1-4.

^ePage 3-12.

^fPage 2-2.

REFERENCE 37 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 27 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| EMISSION FACTORS | | | |
|--|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor (lb/ton) ^c |
| Arsenic ^b | 0.21 | 2.10e-07 | 4.21e-06 |
| Cadmium ^b | 2.1 | 2.10e-06 | 4.21e-05 |
| Chromium ^b | 4.3 | 4.30e-06 | 8.62e-05 |
| Mercury ^b | 67 | 6.70e-05 | 1.34e-03 |
| Nickel | 5.3 | 5.30e-06 | 1.06e-04 |
| Chloride | 1,250 | 1.25e-03 | 2.51e-02 |
| Benzene | 21.1 | 2.11e-05 | 4.23e-04 |
| Naphthalene | 0.76 | 7.60e-07 | 1.52e-05 |
| Acenaphthalene | 0.03 | 3.00e-08 | 6.01e-07 |
| Acenaphthene | 0.08 | 8.00e-08 | 1.60e-06 |
| Fluorene | 0.18 | 1.80e-07 | 3.61e-06 |
| Phenanthrene | 0.13 | 1.30e-07 | 2.61e-06 |
| Anthracene | 0.02 | 2.00e-08 | 4.01e-07 |
| Fluoranthene | 0.03 | 3.00e-08 | 6.01e-07 |
| Pyrene | 0.01 | 1.00e-08 | 2.00e-07 |
| Chrysene ^b | 0.004 | 4.00e-09 | 8.02e-08 |
| Benz(a)anthracene | 0.009 | 9.00e-09 | 1.80e-07 |
| Benzo(b)fluoranthene | 0.008 | 8.00e-09 | 1.60e-07 |
| Benzo(k)fluoranthene | 0.004 | 4.00e-09 | 8.02e-08 |
| Benzo(a)pyrene ^b | 0.004 | 4.00e-09 | 8.02e-08 |
| Indeno(1,2,3-cd)pyrene | 0.004 | 4.00e-09 | 8.02e-08 |
| Benzo(g,h,i)perylene | 0.004 | 4.00e-09 | 8.02e-08 |
| ^a Page 3-15. | | | |
| ^b Emission factor is based only on detection limits. | | | |
| ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 38 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 28 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: FIELD CHEMICAL EMISSIONS MONITORING PROJECT:
SITE 114 REPORT. RADIAN CORPORATION, AUSTIN, TEXAS.
MAY, 1994.

FACILITY: EPRI SITE 114
FILENAME SITE114.tbl

PROCESS DATA

| | |
|-----------------------------------|---|
| Coal type ^a | Bituminous |
| Boiler configuration ^a | Cyclone |
| Coal source ^a | Indiana Lamar |
| SCC | 10100203 |
| Control device 1 ^a | ESP for baseline condition, Reburn/Overfire Air for condition two |
| Control device 2 ^a | None for baseline, ESP for condition two |
| Control device 3 | none |
| Data Quality | A |
| Process Parameters ^a | 100 MW |
| Test methods ^b | EPA, or EPA-approved, test methods |
| Number of test runs ^c | 3 |

| | Baseline | Reburn |
|-------------------------------------|------------|------------|
| Coal HHV, dry (Btu/lb) ^d | 13,490 | 13,280 |
| Coal moisture % ^d | 15.6% | 12.5% |
| Coal HHV, as received (Btu/lb) | 11,670 | 11,804 |
| Coal HHV, as received (Btu/ton) | 23,339,100 | 23,608,889 |
| Coal HHV, as received (MMBtu/ton) | 23.3 | 23.6 |

^aPage 2-1.

^bPage 1-4.

^cPages 3-8 and 3-9.

^dPages 3-4 & 3-5.

REFERENCE 38 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 28 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| EMISSION FACTORS- BASELINE CONDITION | | | |
|--|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Arsenic | 7 | 7.00e-06 | 1.63e-04 |
| Beryllium | 2.4 | 2.40e-06 | 5.60e-05 |
| Cadmium | 1.8 | 1.80e-06 | 4.20e-05 |
| Chromium | 14 | 1.40e-05 | 3.27e-04 |
| Manganese | 20 | 2.00e-05 | 4.67e-04 |
| Nickel | 78 | 7.80e-05 | 1.82e-03 |
| Lead | 86 | 8.60e-05 | 2.01e-03 |
| Selenium | 240 | 2.40e-04 | 5.60e-03 |
| Mercury | 4.5 | 4.50e-06 | 1.05e-04 |
| Chloride | 4,310 | 4.31e-03 | 1.01e-01 |
| Fluoride | 64 | 6.40e-05 | 1.49e-03 |
| Benzene | 2.3 | 2.30e-06 | 5.37e-05 |
| Toluene | 1.02 | 1.02e-06 | 2.38e-05 |
| PAHs ^b | ND | ND | ND |
| Formaldehyde | 2.6 | 2.60e-06 | 6.07e-05 |
| Acetaldehyde | 2.6 | 2.60e-06 | 6.07e-05 |
| ^a Page 3-10. ^b ND = not detected in three runs, no EF calculated. See page 3-8. ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 38 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 28 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| EMISSION FACTORS- REBURN CONDITION | | | |
|--|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor (lb/ton) ^d |
| Arsenic | 8.0 | 8.00e-06 | 1.89e-04 |
| Beryllium | 0.8 | 8.00e-07 | 1.89e-05 |
| Cadmium | 0.4 | 4.00e-07 | 9.44e-06 |
| Chromium | 4.6 | 4.60e-06 | 1.09e-04 |
| Manganese | 15 | 1.50e-05 | 3.54e-04 |
| Nickel | 34 | 3.40e-05 | 8.03e-04 |
| Lead | 57 | 5.70e-05 | 1.35e-03 |
| Selenium | 150 | 1.50e-04 | 3.54e-03 |
| Mercury | 3.8 | 3.80e-06 | 8.97e-05 |
| Chloride | 6,000 | 6.00e-03 | 1.42e-01 |
| Fluoride | 89.9 | 8.99e-05 | 2.12e-03 |
| Benzene | 1.04 | 1.04e-06 | 2.46e-05 |
| Toluene | 0.70 | 7.00e-07 | 1.65e-05 |
| PAHs ^b | ND | ND | ND |
| Formaldehyde ^c | 2.6 | 2.60e-06 | 6.14e-05 |
| Acetaldehyde ^c | 2.6 | 2.60e-06 | 6.14e-05 |
| ^a Page 3-9. ^b ND = not detected in three runs, no EF calculated. See page 3-9. ^c Emission factors based completely on detection limits. ^d Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 39 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 29 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: FIELD CHEMICAL EMISSIONS MONITORING PROJECT:
SITE 115 EMISSIONS REPORT. RADIAN CORPORATION,
AUSTIN, TEXAS. NOVEMBER, 1994.

FACILITY: EPRI SITE 115
FILENAME SITE115.tbl

PROCESS DATA

| | | |
|-------------------------------------|---|--------------------------------------|
| Coal type ^a | Bituminous | |
| Boiler configuration ^b | Pulverized, Dry bottom | |
| Coal source ^a | Western | |
| SCC | 10100202 | |
| | PHASE I | PHASE II |
| Control device 1 ^c | LNB/OFA | LNB/OFA |
| Control device 2 ^c | Fabric Filter | SNCR |
| Control device 3 ^c | none | Fabric Filter |
| Data Quality | B | (coal moisture percent not provided) |
| Process Parameters ^a | 117 MW | |
| Test methods ^d | EPA, or EPA-approved, test methods | |
| Number of test runs ^e | 2 for nickel during Phase I, 3 for all others | |
| | PHASE I | PHASE II |
| Coal HHV, dry (Btu/lb) ^f | 12,565 | 12,638 |
| Coal moisture % ^g | 9.8% | 9.8% |
| Coal HHV, as received (Btu/lb) | 11,444 | 11,510 |
| Coal HHV, as received (Btu/ton) | 22,887,067 | 23,020,036 |
| Coal HHV, as received (MMBtu/ton) | 22.9 | 23.0 |

^aPage 6.

^bPage 6. Assumed dry bottom.

^cPage 6. LNB = Low Nox Burners; OFA = Overfire Air; SNCR = Selective non-catalytic reduction.

^dAppendix A, Table A-1.

^ePage 26 for Phase I, page 35 for Phase II. Also, see footnote to nickel EF in Table 3-4.

^fPage 20 for Phase I; Page 32 for Phase II.

^gThe test report does not provide a moisture content for the coal. EPRI Site 111 (Reference 19) also uses a "western bituminous" coal and the value used here is from that reference.

REFERENCE 39 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 29 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION

| EMISSION FACTORS- PHASE I | | | |
|---|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^d (lb/ton) |
| Arsenic | 0.75 | 7.50e-07 | 1.72e-05 |
| Barium | 1.1 | 1.10e-06 | 2.52e-05 |
| Beryllium ^c | 0.02 | 2.00e-08 | 4.58e-07 |
| Cadmium | 0.12 | 1.20e-07 | 2.75e-06 |
| Chromium | 0.66 | 6.60e-07 | 1.51e-05 |
| Cobalt ^c | 0.22 | 2.20e-07 | 5.04e-06 |
| Copper | 1.1 | 1.10e-06 | 2.52e-05 |
| Lead | 0.44 | 4.40e-07 | 1.01e-05 |
| Manganese | 1.0 | 1.00e-06 | 2.29e-05 |
| Mercury ^c | 0.35 | 3.50e-07 | 8.01e-06 |
| Molybdenum | 0.17 | 1.70e-07 | 3.89e-06 |
| Nickel ^b | 1.5 | 1.50e-06 | 3.43e-05 |
| Phosphorus | 6.7 | 6.70e-06 | 1.53e-04 |
| Selenium | 0.36 | 3.60e-07 | 8.24e-06 |
| Vanadium | 0.24 | 2.40e-07 | 5.49e-06 |
| Chloride | 630 | 6.30e-04 | 1.44e-02 |
| Fluoride | 4,300 | 4.30e-03 | 9.84e-02 |
| Benzene | 2.6 | 2.60e-06 | 5.95e-05 |
| Toluene | 105 | 1.05e-04 | 2.40e-03 |
| Formaldehyde | 16.5 | 1.65e-05 | 3.78e-04 |
| Cyanide | 8 | 8.00e-06 | 1.83e-04 |
| Naphthalene | 0.26 | 2.60e-07 | 5.95e-06 |
| ^a page 28, 29. ND = not detected in 3 runs, no EF developed. See page 26 for run data. | | | |
| ^b One run invalid, data from two runs used to develop EF. | | | |
| ^c Emission factor is based only on detection limits. | | | |
| ^d Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 39 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 29 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION

| EMISSION FACTORS- PHASE II | | | |
|--|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Arsenic | 0.15 | 1.50e-07 | 3.45e-06 |
| Barium | 1.1 | 1.10e-06 | 2.53e-05 |
| Beryllium ^b | 0.02 | 2.00e-08 | 4.60e-07 |
| Cadmium ^b | 0.07 | 7.00e-08 | 1.61e-06 |
| Chromium | 0.30 | 3.00e-07 | 6.91e-06 |
| Cobalt ^b | 0.23 | 2.30e-07 | 5.29e-06 |
| Copper | 1.3 | 1.30e-06 | 2.99e-05 |
| Lead | 0.40 | 4.00e-07 | 9.21e-06 |
| Manganese | 0.89 | 8.90e-07 | 2.05e-05 |
| Mercury | 0.41 | 4.10e-07 | 9.44e-06 |
| Molybdenum | 0.27 | 2.70e-07 | 6.22e-06 |
| Nickel | 0.45 | 4.50e-07 | 1.04e-05 |
| Phosphorus | 4.6 | 4.60e-06 | 1.06e-04 |
| Selenium ^b | 0.06 | 6.00e-08 | 1.38e-06 |
| Vanadium | 0.29 | 2.90e-07 | 6.68e-06 |
| Chloride | 720 | 7.20e-04 | 1.66e-02 |
| Fluoride | 4,800 | 4.80e-03 | 1.10e-01 |
| Cyanide | 9 | 9.00e-06 | 2.07e-04 |
| ^a Page 37. ^b Emission factor is based only on detection limits. ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 40 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 30 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: CHARACTERIZING TOXIC EMISSIONS FROM A COAL-FIRED POWER PLANT DEMONSTRATING THE AFGD ICCT PROJECT AND A PLANT UTILIZING A DRY SCRUBBER/BAGHOUSE SYSTEM. SPRINGERVILLE GENERATING STATION UNIT NO. 2. SOUTHERN RESEARCH INSTITUTE, BIRMINGHAM, AL. DECEMBER, 1993.

FACILITY: Springerville, Arizona
FILENAME DOE7.tbl

PROCESS DATA

| | |
|---|--|
| Coal type ^a | Subbituminous |
| Boiler configuration ^b | Pulverized, dry bottom, tangential |
| Coal source ^a | New Mexico |
| SCC | 10100226 |
| Control device 1 ^a | Low Nox Burners- Overfire Air (LNB/OFA) |
| Control device 2 ^a | Flue Gas Desulfurization- Spray Dryer (FGD-SD) |
| Control device 3 ^a | Baghouse |
| Data Quality | A |
| Process Parameters ^a | 422 MW |
| Test methods ^c | EPA, or EPA-approved, test methods |
| Number of test runs ^d | 2 for selenium, cadmium and manganese, 3 for others. |
| Coal HHV, as received (Btu/lb) ^e | 9,446 |
| Coal HHV, as received (Btu/ton) | 18,892,000 |
| Coal HHV, as received (MMBtu/ton) | 18.9 |

^aPage 3-1.

^b"Pulverized" from page 3-1, assumed dry bottom,

"Tangential" from Appendix B of EPRI Synthesis Report. Page B-7.

^cPage 4-2.

^dPages 6-53, 6-54, and 6-55.

^ePage 6-2, average for conveyor.

REFERENCE 40 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 30 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| EMISSION FACTORS | | | |
|--|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Antimony | 0.041 | 4.10e-08 | 7.75e-07 |
| Arsenic | 0.15 | 1.50e-07 | 2.83e-06 |
| Barium | 14.1 | 1.41e-05 | 2.66e-04 |
| Beryllium ^b | 0.04 | 4.00e-08 | 7.56e-07 |
| Boron | 609 | 6.09e-04 | 1.15e-02 |
| Cadmium | 0.026 | 2.60e-08 | 4.91e-07 |
| Chromium | 0.10 | 1.00e-07 | 1.89e-06 |
| Cobalt ^b | 0.3 | 3.00e-07 | 5.67e-06 |
| Copper | 0.98 | 9.80e-07 | 1.85e-05 |
| Lead | 0.70 | 7.00e-07 | 1.32e-05 |
| Manganese | 11.36 | 1.14e-05 | 2.15e-04 |
| Mercury | 4.18 | 4.18e-06 | 7.90e-05 |
| Molybdenum | 1.4 | 1.40e-06 | 2.64e-05 |
| Nickel ^b | 0.3 | 3.00e-07 | 5.67e-06 |
| Selenium ^b | 0.038 | 3.80e-08 | 7.18e-07 |
| Vanadium | 1.0 | 1.00e-06 | 1.89e-05 |
| ^a Page 1-11. | | | |
| ^b Emission factor is based only on detection limits. | | | |
| ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 41 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 31 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: A STUDY OF TOXIC EMISSIONS FROM A COAL-FIRED POWER
PLANT- NILES STATION BOILER NO. 2. BATTELLE,
COLUMBUS, OHIO. DECEMBER 29, 1993.

FACILITY: Niles, Ohio
FILENAME DOE2.tbl

| | | | |
|---|--|-----------------|------------------------------|
| PROCESS DATA | | | |
| Coal type ^a | Bituminous | | |
| Boiler configuration ^a | Cyclone | | |
| Coal source ^a | Ohio/W. Pa. | | |
| SCC | 10100203 | | |
| Control device 1 ^a | ESP | | |
| Control device 2 | None | | |
| Control device 3 | None | | |
| Data Quality | A | | |
| Process Parameters ^a | 108 MW | | |
| Test methods | Assumed EPA, or EPA-approved, test methods | | |
| Number of test runs ^b | 3 | | |
| Coal HHV, as received (Btu/lb) ^c | 12,184 | | |
| Coal HHV, as received (Btu/ton) | 24,368,000 | | |
| Coal HHV, as received (MMBtu/ton) | 24.4 | | |
| ^a Page 2-1. | | | |
| ^b Pages 6-24, 6-26, 6-27, 6-28, 6-30, 6-32, 6-33, 6-35. | | | |
| ^c Page 2-18. Average of 11964, 12504, 12397, 12139, 12031, and 12068 Btu/lb. | | | |
| METALS EMISSION FACTORS | | | |
| | Emission Factor ^a | Emission Factor | Emission Factor ^c |
| Pollutant | (lb/10 ¹² Btu) | (lb/MMBtu) | (lb/ton) |
| Aluminum | 1114 | 1.11e-03 | 2.71e-02 |
| Antimony ^b | 0.18 | 1.80e-07 | 4.39e-06 |
| Arsenic | 42 | 4.20e-05 | 1.02e-03 |
| Barium | 5.4 | 5.40e-06 | 1.32e-04 |
| Beryllium | 0.19 | 1.90e-07 | 4.63e-06 |
| Cadmium | 0.07 | 7.00e-08 | 1.71e-06 |

REFERENCE 41 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 31 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS EMISSION FACTORS | | | |
|--|--|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ⁶ Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Chromium | 3.0 | 3.00e-06 | 7.31e-05 |
| Cobalt ^b | 0.06 | 6.00e-08 | 1.46e-06 |
| Copper | 4.0 | 4.00e-06 | 9.75e-05 |
| Lead | 1.6 | 1.60e-06 | 3.90e-05 |
| Manganese | 3.4 | 3.40e-06 | 8.29e-05 |
| Mercury | 14 | 1.40e-05 | 3.41e-04 |
| Molybdenum | 2.3 | 2.30e-06 | 5.60e-05 |
| Nickel | 0.55 | 5.50e-07 | 1.34e-05 |
| Potassium | 705 | 7.05e-04 | 1.72e-02 |
| Selenium | 62.0 | 6.20e-05 | 1.51e-03 |
| Sodium | 1767 | 1.77e-03 | 4.31e-02 |
| Titanium | 23 | 2.30e-05 | 5.60e-04 |
| Vanadium | 2.5 | 2.50e-06 | 6.09e-05 |
| ^a Page 6-24, "Average" values. ^b Pollutant was not detected in any of the sampling runs. EF is based on detection limits (1/2). ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |
| AMMONIA/CYANIDE EMISSION FACTORS | | | |
| Pollutant | Emission Factor (lb/10 ⁶ Btu) ^a | Emission Factor (lb/MMBtu) | Emission Factor (lb/ton) ^c |
| Ammonia ^b | 70 | 7.00e-05 | 1.71e-03 |
| Cyanide | 180 | 1.80e-04 | 4.39e-03 |
| ^a Page 6-26, Table 6-8, "Average" values. ^b Detection limit values (1/2) for two runs used in developing EF. ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |
| HCl, HF EMISSION FACTORS | | | |
| Pollutant | Emission Factor (lb/10 ⁶ Btu) ^a | Emission Factor (lb/MMBtu) | Emission Factor (lb/ton) ^b |
| Hydrogen Chloride | 132,049 | 1.32e-01 | 3.22e+00 |
| Hydrogen Fluoride | 8,921 | 8.92e-03 | 2.17e-01 |
| ^a Page 6-27, Table 6-10, "Average" values. ^b Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 41 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 31 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| ORGANIC EMISSION FACTORS | | | |
|--|--|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ⁶ Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Chloromethane (Methyl Chloride) | 4.9 | 4.90e-06 | 1.19e-04 |
| Bromomethane (Methyl Bromide) ^b | 3.2 | 3.20e-06 | 7.80e-05 |
| Vinyl Chloride ^b | 2.5 | 2.50e-06 | 6.09e-05 |
| Chloroethane (Ethyl Chloride) ^b | 2.5 | 2.50e-06 | 6.09e-05 |
| Carbon Disulfide | 5.9 | 5.90e-06 | 1.44e-04 |
| 1,1-Dichloroethane (Ethylidene Dichloride) ^b | 2.5 | 2.50e-06 | 6.09e-05 |
| Chloroform ^b | 2.5 | 2.50e-06 | 6.09e-05 |
| 1,2-Dichloroethane (Ethylene Dichloride) ^b | 2.5 | 2.50e-06 | 6.09e-05 |
| 2-Butanone (Methyl Ethyl Ketone) | 5.1 | 5.10e-06 | 1.24e-04 |
| 1,1,1-Trichloroethane ^b | 2.5 | 2.50e-06 | 6.09e-05 |
| Carbon Tetrachloride ^b | 2.5 | 2.50e-06 | 6.09e-05 |
| Vinyl Acetate ^b | 2.5 | 2.50e-06 | 6.09e-05 |
| 1,2-Dichloropropane (Propylene Dichloride) ^b | 2.5 | 2.50e-06 | 6.09e-05 |
| Trichloroethene ^b | 2.5 | 2.50e-06 | 6.09e-05 |
| 1,1,2-Trichloroethane ^b | 2.4 | 2.40e-06 | 5.85e-05 |
| Benzene | 7.9 | 7.90e-06 | 1.93e-04 |
| 1,3-Dichloropropylene ^b | 2.5 | 2.50e-06 | 6.09e-05 |
| Bromoform ^b | 2.4 | 2.40e-06 | 5.85e-05 |
| Tetrachloroethene | 3.1 | 3.10e-06 | 7.55e-05 |
| 1,1,2,2-Tetrachloroethane ^b | 2.5 | 2.50e-06 | 6.09e-05 |
| Toluene | 3.5 | 3.50e-06 | 8.53e-05 |
| Chlorobenzene ^b | 2.5 | 2.50e-06 | 6.09e-05 |
| Ethylbenzene ^b | 2.5 | 2.50e-06 | 6.09e-05 |
| Styrene ^b | 2.5 | 2.50e-06 | 6.09e-05 |
| Xylenes ^b | 2.5 | 2.50e-06 | 6.09e-05 |
| ^a Page 6-28 (189 HAPs, only). | | | |
| ^b Pollutant not detected in any sampling runs. EF is based on detection limits (1/2). | | | |
| ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 41 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 31 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| PAH/ORGANIC EMISSION FACTORS | | | |
|--|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Benzyl chloride ^b | 0.0059 | 5.90e-09 | 1.44e-07 |
| Acetophenone | 0.6360 | 6.36e-07 | 1.55e-05 |
| Hexachloroethane ^b | 0.0059 | 5.90e-09 | 1.44e-07 |
| Naphthalene | 0.2153 | 2.15e-07 | 5.25e-06 |
| Hexachlorobutadiene ^b | 0.0059 | 5.90e-09 | 1.44e-07 |
| 2-Chloroacetophenone | 0.2879 | 2.88e-07 | 7.02e-06 |
| Biphenyl | 0.1257 | 1.26e-07 | 3.06e-06 |
| Acenaphthylene | 0.0068 | 6.80e-09 | 1.66e-07 |
| Acenaphthene | 0.0265 | 2.65e-08 | 6.46e-07 |
| Dibenzofurans | 0.0654 | 6.54e-08 | 1.59e-06 |
| 2,4-Dinitrotoluene | 0.0197 | 1.97e-08 | 4.80e-07 |
| Fluorene | 0.0313 | 3.13e-08 | 7.63e-07 |
| Hexachlorobenzene ^b | 0.0059 | 5.90e-09 | 1.44e-07 |
| Phenanthrene | 0.0776 | 7.76e-08 | 1.89e-06 |
| Anthracene | 0.0207 | 2.07e-08 | 5.04e-07 |
| Fluoranthene | 0.0270 | 2.70e-08 | 6.58e-07 |
| Pyrene | 0.0139 | 1.39e-08 | 3.39e-07 |
| Benz(a)anthracene | 0.0037 | 3.70e-09 | 9.02e-08 |
| Chrysene | 0.0089 | 8.90e-09 | 2.17e-07 |
| Benzo(b,k)fluoranthene | 0.0070 | 7.00e-09 | 1.71e-07 |
| Benzo(a)pyrene ^b | 0.0012 | 1.20e-09 | 2.92e-08 |
| Indeno(1,2,3-c,d)pyrene ^b | 0.0012 | 1.20e-09 | 2.92e-08 |
| Benzo(g,h,i)perylene ^b | 0.0012 | 1.20e-09 | 2.92e-08 |
| ^a Page 6-30 (most common PAHs, 189 HAPs). | | | |
| ^b Pollutant not detected in any sampling runs. EF is based on detection limits (1/2). | | | |
| ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 41 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 31 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| DIOXINS/FURANS EMISSION FACTORS | | | |
|---|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| 2,3,7,8-TCDD ^b | 1.05e-06 | 1.05e-12 | 2.56e-11 |
| OCDD | 1.89e-05 | 1.89e-11 | 4.61e-10 |
| 2,3,7,8-TCDF | 4.76e-06 | 4.76e-12 | 1.16e-10 |
| OCDF | 1.95e-05 | 1.95e-11 | 4.75e-10 |
| ^a Page 6-32. ^b Pollutant not detected in any sampling runs. EF is based on detection limits (1/2). ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |
| ALDEHYDES EMISSION FACTORS | | | |
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^b (lb/ton) |
| Formaldehyde | 3.9 | 3.90e-06 | 9.50e-05 |
| Acetaldehyde | 89 | 8.90e-05 | 2.17e-03 |
| Acrolein | 41 | 4.10e-05 | 9.99e-04 |
| Propionaldehyde | 25 | 2.50e-05 | 6.09e-04 |
| ^a Page 6-33. ^b Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 42 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 32 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: A STUDY OF TOXIC EMISSIONS FROM A COAL-FIRED POWER
PLANT UTILIZING AN ESP/WET FGD SYSTEM. BATTELLE,
COLUMBUS, OHIO. DECEMBER 29, 1993.

FACILITY: Underwood, North Dakota
FILENAME DOE6.tbl

PROCESS DATA

| | |
|---|---|
| Coal type ^a | Lignite |
| Boiler configuration ^a | Pulverized, Dry bottom, tangential |
| Coal source ^a | North Dakota |
| SCC | 10100302 |
| Control device 1 ^a | ESP |
| Control device 2 ^b | Flue Gas Desulfurization- Wet Limestone Scrubber (FGD-WLS) |
| Control device 3 | None |
| Data Quality | A |
| Process Parameters ^c | 550 MW |
| Test methods ^d | Assumed EPA, or EPA-approved, test methods |
| Number of test runs ^e | 2,3 |
| Coal HHV, as received (Btu/lb) ^f | 6,230 |
| Coal HHV, as received (Btu/ton) | 12,460,000 |
| Coal HHV, as received (MMBtu/ton) | 12.5 |

^aPage 2-1.

^bPages 2-1, 2-4, and 2-5.

^cPage 2-1. 2 identical units @ 1,100 MW- one unit = 550 MW.

^dPage 3-26.

^eSee pages referenced below by groups of EFs.

^fPage 2-33, average of "As received" values.

REFERENCE 42 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 32 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS EMISSION FACTORS | | | |
|--|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^d (lb/ton) |
| Aluminum | 578 | 5.78e-04 | 7.20e-03 |
| Antimony | 0.18 | 1.80e-07 | 2.24e-06 |
| Arsenic | 1.2 | 1.20e-06 | 1.50e-05 |
| Barium | 162 | 1.62e-04 | 2.02e-03 |
| Beryllium ^b | 0.85 | 8.50e-07 | 1.06e-05 |
| Boron | 19 | 1.90e-05 | 2.37e-04 |
| Cadmium ^b | 1.6 | 1.60e-06 | 1.99e-05 |
| Calcium | 1308 | 1.31e-03 | 1.63e-02 |
| Chromium ^c | 10.0 | 1.00e-05 | 1.25e-04 |
| Cobalt | 1.5 | 1.50e-06 | 1.87e-05 |
| Copper | 4.9 | 4.90e-06 | 6.11e-05 |
| Lead | 0.69 | 6.90e-07 | 8.60e-06 |
| Manganese | 30 | 3.00e-05 | 3.74e-04 |
| Mercury | 9.5 | 9.50e-06 | 1.18e-04 |
| Molybdenum ^c | 0.51 | 5.10e-07 | 6.35e-06 |
| Nickel ^c | 5.1 | 5.10e-06 | 6.35e-05 |
| Potassium | 109 | 1.09e-04 | 1.36e-03 |
| Selenium | 8.3 | 8.30e-06 | 1.03e-04 |
| Sodium | 218 | 2.18e-04 | 2.72e-03 |
| Titanium | 42 | 4.20e-05 | 5.23e-04 |
| Vanadium | 4.4 | 4.40e-06 | 5.48e-05 |
| ^a Page 6-76, "Average" values. ^b Pollutant was not detected in any of the sampling runs. EF is based on detection limits (1/2). ^c Data from one run not used, EF based on data from two runs. ^d Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 42 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 32 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| AMMONIA/CYANIDE EMISSION FACTORS | | | |
|---|--|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ⁶ Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Ammonia ^b | 1.9 | 1.90e-06 | 2.37e-05 |
| Cyanide | 51 | 5.10e-05 | 6.35e-04 |
| ^a Page 6-78. ^b Pollutant was not detected in any sampling runs. EF is based on detection limits (1/2). ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |
| HCl, HFI EMISSION FACTORS | | | |
| Pollutant | Emission Factor (lb/10 ⁶ Btu) ^a | Emission Factor (lb/MMBtu) | Emission Factor (lb/ton) ^b |
| Hydrogen Chloride | 1,339 | 1.34e-03 | 1.67e-02 |
| Hydrogen Fluoride | 3,976 | 3.98e-03 | 4.95e-02 |
| ^a Page 6-80. ^b Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |
| -ORGANIC EMISSION FACTORS | | | |
| Pollutant | Emission Factor ^a (lb/10 ⁶ Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Chloromethane (Methyl Chloride) | 106 | 1.06e-04 | 1.32e-03 |
| Bromomethane (Methyl Bromide) | 4.3 | 4.30e-06 | 5.36e-05 |
| Vinyl Chloride ^b | 3.2 | 3.20e-06 | 3.99e-05 |
| Chloroethane (Ethyl Chloride) ^b | 3.2 | 3.20e-06 | 3.99e-05 |
| Carbon Disulfide | 3.4 | 3.40e-06 | 4.24e-05 |
| 1,1-Dichloroethane (Ethylidene Dichloride) ^b | 3.2 | 3.20e-06 | 3.99e-05 |
| Chloroform ^b | 3.2 | 3.20e-06 | 3.99e-05 |
| 1,2-Dichloroethane (Ethylene Dichloride) | 3.2 | 3.20e-06 | 3.99e-05 |
| 2-Butanone (Methyl Ethyl Ketone) | 9.8 | 9.80e-06 | 1.22e-04 |
| 1,1,1-Trichloroethane ^b | 3.2 | 3.20e-06 | 3.99e-05 |
| Carbon Tetrachloride ^b | 3.2 | 3.20e-06 | 3.99e-05 |
| Vinyl Acetate ^b | 3.2 | 3.20e-06 | 3.99e-05 |

REFERENCE 42 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 32 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| ORGANIC EMISSION FACTORS | | | |
|---|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| 1,2-Dichloropropane (Propylene Dichloride) ^b | 3.2 | 3.20e-06 | 3.99e-05 |
| Trichloroethene ^b | 3.2 | 3.20e-06 | 3.99e-05 |
| 1,1,2-Trichloroethane ^b | 3.2 | 3.20e-06 | 3.99e-05 |
| Benzene | 41 | 4.10e-05 | 5.11e-04 |
| 1,3-Dichloropropylene ^b | 3.2 | 3.20e-06 | 3.99e-05 |
| Bromoform | 3.1 | 3.10e-06 | 3.86e-05 |
| Tetrachloroethene ^b | 3.2 | 3.20e-06 | 3.99e-05 |
| 1,1,2,2-Tetrachloroethane ^b | 3.2 | 3.20e-06 | 3.99e-05 |
| Toluene | 24 | 2.40e-05 | 2.99e-04 |
| Chlorobenzene | 3.3 | 3.30e-06 | 4.11e-05 |
| Ethylbenzene ^b | 3.2 | 3.20e-06 | 3.99e-05 |
| Styrene | 3.3 | 3.30e-06 | 4.11e-05 |
| Xylenes | 3.5 | 3.50e-06 | 4.36e-05 |
| ^a Page 6-82 (only 189 HAPs). ^b Pollutant was not detected in any sampling runs. EF is based on detection limits (1/2). ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |
| PAH/SVOC EMISSION FACTORS | | | |
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Naphthalene | 0.2549 | 2.55e-07 | 3.18e-06 |
| Acenaphthene | 0.0173 | 1.73e-08 | 2.16e-07 |
| Dibenzofurans | 0.0516 | 5.16e-08 | 6.43e-07 |
| 2,4-Dinitrotoluene | 0.0065 | 6.50e-09 | 8.10e-08 |
| Fluorene | 0.0415 | 4.15e-08 | 5.17e-07 |
| Hexachlorobenzene ^b | 0.0009 | 9.00e-10 | 1.12e-08 |
| Phenanthrene | 0.3142 | 3.14e-07 | 3.91e-06 |
| Anthracene | 0.0147 | 1.47e-08 | 1.83e-07 |
| Fluoranthene | 0.0422 | 4.22e-08 | 5.26e-07 |

REFERENCE 42 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 32 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| PAH/SVOC EMISSION FACTORS | | | |
|--|---|-------------------------------|---|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Pyrene | 0.0162 | 1.62e-08 | 2.02e-07 |
| Benz(a)anthracene | 0.0021 | 2.10e-09 | 2.62e-08 |
| Chrysene | 0.0053 | 5.30e-09 | 6.60e-08 |
| Benzo(b,k)fluoranthene | 0.0045 | 4.50e-09 | 5.61e-08 |
| Benzo(a)pyrene | 0.0009 | 9.00e-10 | 1.12e-08 |
| Indeno(1,2,3-c,d)pyrene | 0.0006 | 6.00e-10 | 7.48e-09 |
| Benzo(g,h,i)perylene | 0.0006 | 6.00e-10 | 7.48e-09 |
| Biphenyl | 0.0230 | 2.30e-08 | 2.87e-07 |
| Acetophenone | 0.5425 | 5.43e-07 | 6.76e-06 |
| Acenaphthylene | 0.0105 | 1.05e-08 | 1.31e-07 |
| Benzyl Chloride | 0.0057 | 5.70e-09 | 7.10e-08 |
| ^a Page 6-84.(most common.PAHs, 189 HAPs). ^b Pollutant was not detected in any sampling runs. EF is based on detection limits (1/2). ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |
| DIOXINS/FURANS EMISSION FACTORS | | | |
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) ^c |
| 2,3,7,8-TCDD ^b | 9.90e-07 | 9.90e-13 | 1.23e-11 |
| OCDD | 1.51e-05 | 1.51e-11 | 1.88e-10 |
| 2,3,7,8-TCDF | 9.89e-06 | 9.89e-12 | 1.23e-10 |
| OCDF | 6.29e-06 | 6.29e-12 | 7.84e-11 |
| ^a Page 6-86. ^b Pollutant was not detected in any sampling runs. EF is based on detection limits (1/2). ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 42 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 32 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| ALDEHYDES EMISSION FACTORS | | | |
|---|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Formaldehyde ^b | 1.8 | 1.80e-06 | 2.24e-05 |
| Acetaldehyde | 67 | 6.70e-05 | 8.35e-04 |
| Acrolein | 1.1 | 1.10e-06 | 1.37e-05 |
| Propionaldehyde | 12 | 1.20e-05 | 1.50e-04 |
| ^a Page 6-88. ^b Pollutant was not detected in any sampling runs. EF is based on detection limits (1/2). ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 43 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 33 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: TOXICS ASSESSMENT REPORT. ILLINOIS POWER COMPANY.
BALDWIN POWER STATION-UNIT 2. VOLUMES I
THROUGH IV. ROY F. WESTON, INC. DECEMBER, 1993

FACILITY: Baldwin, Illinois
FILENAME DOE3.tbl

PROCESS DATA

| | |
|---|---|
| Coal type ^a | Bituminous |
| Boiler configuration ^a | Cyclone |
| Coal source ^a | Illinois |
| SCC | 10100203 |
| Control device 1 ^b | ESP |
| Control device 2 | None |
| Control device 3 | None |
| Data Quality | A |
| Process Parameters ^a | 568 MW |
| Test methods ^c | EPA, or EPA-approved, test methods |
| Number of test runs ^d | 6 for filterable PM, 3 for other pollutants |
| Coal HHV, as received (Btu/lb) ^e | 10,633 |
| Coal HHV, as received (Btu/ton) | 21,266,000 |
| Coal HHV, as received (MMBtu/ton) | 21.3 |

^aPage 2-1.

^bPage 2-4.

^cPage 1-12.

^dSee pages referenced below by groups of EFs.

^ePage 2-23. Average of 10765, 10681, 10722, 10412, 10426 and 10794 Btu/lb, as received, non-soot blowing periods.

METALS EMISSION FACTORS

| Pollutant | Emission Factor (lb/10 ¹² Btu) ^a | Emission Factor (lb/MMBtu) | Emission Factor (lb/ton) ^b |
|-----------|---|-------------------------------|--|
| Aluminum | 5.55e+03 | 5.55e-03 | 1.18e-01 |
| Antimony | 1.52e+00 | 1.52e-06 | 3.23e-05 |
| Arsenic | 1.34e+01 | 1.34e-05 | 2.85e-04 |
| Barium | 5.32e+00 | 5.32e-06 | 1.13e-04 |
| Beryllium | 1.41e+00 | 1.41e-06 | 3.00e-05 |

REFERENCE 43 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 33 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS EMISSION FACTORS | | | |
|--|---|-------------------------------|--|
| Pollutant | Emission Factor (lb/10 ¹² Btu) ^a | Emission Factor (lb/MMBtu) | Emission Factor (lb/ton) ^b |
| Boron | 7.67e+03 | 7.67e-03 | 1.63e-01 |
| Cadmium | 3.02e+00 | 3.02e-06 | 6.42e-05 |
| Calcium | 3.25e+02 | 3.25e-04 | 6.91e-03 |
| Chromium | 5.06e+01 | 5.06e-05 | 1.08e-03 |
| Cobalt | 6.80e+00 | 6.80e-06 | 1.45e-04 |
| Copper | 1.89e+01 | 1.89e-05 | 4.02e-04 |
| Iron | 8.39e+03 | 8.39e-03 | 1.78e-01 |
| Lead | 2.86e+01 | 2.86e-05 | 6.08e-04 |
| Magnesium | 2.90e+02 | 2.90e-04 | 6.17e-03 |
| Manganese | 2.23e+01 | 2.23e-05 | 4.74e-04 |
| Mercury | 3.83e+00 | 3.83e-06 | 8.14e-05 |
| Molybdenum | 3.37e+01 | 3.37e-05 | 7.17e-04 |
| Nickel | 2.21e+01 | 2.21e-05 | 4.70e-04 |
| Potassium | 9.33e+02 | 9.33e-04 | 1.98e-02 |
| Phosphorous | 1.98e+02 | 1.98e-04 | 4.21e-03 |
| Selenium | 1.30e+02 | 1.30e-04 | 2.76e-03 |
| Sodium | 1.17e+03 | 1.17e-03 | 2.49e-02 |
| Titanium | 3.82e+02 | 3.82e-04 | 8.12e-03 |
| Vanadium | 1.00e+02 | 1.00e-04 | 2.13e-03 |
| ^a Page 4-18, "Average" values. | | | |
| ^b Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 43 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 33 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| ORGANICS EMISSION FACTORS | | | |
|---|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Phenol | 1.15e+00 | 1.15e-06 | 2.45e-05 |
| Acetophenone | 1.23e+00 | 1.23e-06 | 2.62e-05 |
| Isophorone | 2.62e+01 | 2.62e-05 | 5.57e-04 |
| Biphenyl ^b | 8.78e-01 | 8.78e-07 | 1.87e-05 |
| Di-n-butylphthalate | 3.00e+00 | 3.00e-06 | 6.38e-05 |
| bis(2-Ethylhexyl)phthalate | 4.60e+00 | 4.60e-06 | 9.78e-05 |
| ^a Page 4-74. ^b Emission factor based on only non-detects. ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |
| PAH EMISSION FACTORS | | | |
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Naphthalene | 3.94e-01 | 3.94e-07 | 8.38e-06 |
| Acenaphthylene | 3.19e-02 | 3.19e-08 | 6.78e-07 |
| Acenaphthene ^b | 6.32e-03 | 6.32e-09 | 1.34e-07 |
| Fluorene | 4.87e-03 | 4.87e-09 | 1.04e-07 |
| Phenanthrene | 5.69e-02 | 5.69e-08 | 1.21e-06 |
| Anthracene | 2.64e-03 | 2.64e-09 | 5.61e-08 |
| Fluoranthene | 1.74e-02 | 1.74e-08 | 3.70e-07 |
| Pyrene | 2.82e-03 | 2.82e-09 | 6.00e-08 |
| Benz(a)anthracene ^b | 1.17e-03 | 1.17e-09 | 2.49e-08 |
| Benzo(b,k)fluoranthene | 3.91e-03 | 3.91e-09 | 8.32e-08 |
| Benzo(a)pyrene ^b | 5.44e-04 | 5.44e-10 | 1.16e-08 |
| Indeno(1,2,3-c,d)pyrene ^b | 1.11e-03 | 1.11e-09 | 2.36e-08 |
| Benzo(g,h,i)perylene ^b | 1.13e-03 | 1.13e-09 | 2.40e-08 |
| ^a Page 4-74. ^b Pollutant not detected in any sampling runs. EF is based on detection limits. ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 43 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 33 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| DIOXINS/FURANS EMISSION FACTORS | | | |
|--|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| 2,3,7,8-TCDD ^b | 2.54e-06 | 2.54e-12 | 5.40e-11 |
| Total TCDD | 1.34e-06 | 1.34e-12 | 2.85e-11 |
| Total PeCDD ^b | 7.37e-07 | 7.37e-13 | 1.57e-11 |
| Total HxCDD | 9.59e-07 | 9.59e-13 | 2.04e-11 |
| Total HpCDD | 2.53e-06 | 2.53e-12 | 5.38e-11 |
| Total OCDD ^b | 8.91e-06 | 8.91e-12 | 1.89e-10 |
| 2,3,7,8-TCDF ^b | 1.27e-06 | 1.27e-12 | 2.70e-11 |
| Total TCDF ^b | 3.82e-06 | 3.82e-12 | 8.12e-11 |
| Total PeCDF | 3.99e-06 | 3.99e-12 | 8.49e-11 |
| Total HxCDF | 5.57e-06 | 5.57e-12 | 1.18e-10 |
| Total HpCDF | 3.17e-06 | 3.17e-12 | 6.74e-11 |
| Total OCDF | 4.15e-06 | 4.15e-12 | 8.83e-11 |
| ^a Page 4-76. ^b Pollutant not detected in any sampling runs. ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |
| ALDEHYDES/KETONES EMISSION FACTORS | | | |
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Formaldehyde | 1.68e+00 | 1.68e-06 | 3.57e-05 |
| Acetaldehyde | 1.37e+01 | 1.37e-05 | 2.91e-04 |
| Acrolein | 3.55e+00 | 3.55e-06 | 7.55e-05 |
| Methyl Ethyl Ketone | 3.70e+00 | 3.70e-06 | 7.87e-05 |
| ^a Page 4-78, ESP Outlet data, only 189 HAPs. ^b Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 43 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 33 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| ORGANICS EMISSION FACTORS | | | |
|---|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Bromomethane (Methyl Bromide) | 9.70e-01 | 9.70e-07 | 2.06e-05 |
| Carbon Disulfide | 1.37e-01 | 1.37e-07 | 2.91e-06 |
| Methylene Chloride ^b | 1.83e+01 | 1.83e-05 | 3.89e-04 |
| Hexane | 1.64e-01 | 1.64e-07 | 3.49e-06 |
| Benzene | 1.21e+02 | 1.21e-04 | 2.57e-03 |
| Toluene ^b | 2.00e+00 | 2.00e-06 | 4.25e-05 |
| Ethylbenzene | 1.26e-01 | 1.26e-07 | 2.68e-06 |
| Xylenes(m/p + o) | 1.87e+00 | 1.87e-06 | 3.97e-05 |
| Styrene | 1.99e-01 | 1.99e-07 | 4.23e-06 |
| ^a Page 4-80. ^b Results suspected to be biased by lab solvents, do not use. ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 44 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 34 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: TOXICS ASSESSMENT REPORT. MINNESOTA POWER
COMPANY BOSWELL ENERGY CENTER UNIT 2. COHASSET,
MINNESOTA. VOLUME 1- MAIN REPORT. ROY F. WESTON,
INC. WEST CHESTER, PENNSYLVANIA. DECEMBER, 1993.

FACILITY: Cohasset, Minnesota
FILENAME DOE8.tbl

| | | | |
|---|------------------------------------|-------|-------|
| PROCESS DATA | | | |
| Coal type ^a | Subbituminous | | |
| Boiler configuration ^b | Pulverized, Dry bottom | | |
| Coal source ^a | Montana/Wyoming | | |
| SCC | 10100222 | | |
| Control device 1 ^c | Baghouse | | |
| Control device 2 | None | | |
| Control device 3 | None | | |
| Data Quality | A | | |
| Process Parameters ^a | 69 MW | | |
| Test methods ^d | EPA, or EPA-approved, test methods | | |
| Number of test runs ^e | 3 | | 8,692 |
| | | | 8,749 |
| Coal HHV, as received (Btu/lb) ^f | 8,798 | | 8,839 |
| Coal HHV, as received (Btu/ton) | 17,596,000 | | 8,815 |
| Coal HHV, as received (MMBtu/ton) | 17.6 | | 8,871 |
| | | | 8,820 |
| | | ----- | |
| | | avg | 8,798 |
| ^a Page 2-1. ^b Page 2-1 for "pulverized", assumed dry bottom. ^c Page 2-4. ^d Page 1-12. ^e See pages listing emission factors. ^f Page 2-23, average of 8692, 8749, 8839, 8815, 8871, 8820 Btu/lb. | | | |

REFERENCE 44 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 34 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS EMISSION FACTORS | | | |
|---|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Aluminum | 1.93e+03 | 1.93e-03 | 3.40e-02 |
| Antimony ^b | 6.77e-01 | 6.77e-07 | 1.19e-05 |
| Arsenic | 3.24e-01 | 3.24e-07 | 5.70e-06 |
| Barium | 8.16e+01 | 8.16e-05 | 1.44e-03 |
| Beryllium ^b | 1.29e-01 | 1.29e-07 | 2.27e-06 |
| Boron | 6.09e+02 | 6.09e-04 | 1.07e-02 |
| Cadmium ^b | 6.48e-01 | 6.48e-07 | 1.14e-05 |
| Calcium | 4.76e+02 | 4.76e-04 | 8.38e-03 |
| Chromium | 2.04e+00 | 2.04e-06 | 3.59e-05 |
| Cobalt | 7.01e-01 | 7.01e-07 | 1.23e-05 |
| Copper | 2.40e+00 | 2.40e-06 | 4.22e-05 |
| Iron | 4.12e+02 | 4.12e-04 | 7.25e-03 |
| Lead | 2.44e+00 | 2.44e-06 | 4.29e-05 |
| Magnesium | 2.05e+02 | 2.05e-04 | 3.61e-03 |
| Manganese | 1.84e+01 | 1.84e-05 | 3.24e-04 |
| Mercury | 1.93e+00 | 1.93e-06 | 3.40e-05 |
| Molybdenum | 1.29e+00 | 1.29e-06 | 2.27e-05 |
| Nickel | 1.97e+00 | 1.97e-06 | 3.47e-05 |
| Potassium | 5.71e+01 | 5.71e-05 | 1.00e-03 |
| Phosphorous | 2.67e+01 | 2.67e-05 | 4.70e-04 |
| Selenium | 3.23e+00 | 3.23e-06 | 5.68e-05 |
| Sodium | 1.97e+02 | 1.97e-04 | 3.47e-03 |
| Titanium | 5.78e+01 | 5.78e-05 | 1.02e-03 |
| Vanadium | 1.53e+00 | 1.53e-06 | 2.69e-05 |
| ^a Page 4-14, "Average" values. ^b Pollutant not detected in any sampling runs. EF is based on detection limits. ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 44 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 34 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| ORGANICS EMISSION FACTORS | | | |
|---|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| n-Nitrosodimethylamine ^b | 8.87e-01 | 8.87e-07 | 1.56e-05 |
| Phenol | 4.29e-01 | 4.29e-07 | 7.55e-06 |
| Acetophenone | 7.13e-01 | 7.13e-07 | 1.25e-05 |
| Biphenyl ^b | 1.78e-01 | 1.78e-07 | 3.13e-06 |
| Di-n-butylphthalate ^b | 1.94e+00 | 1.94e-06 | 3.41e-05 |
| bis(2-Ethylhexyl)phthalate | 1.68e+00 | 1.68e-06 | 2.96e-05 |
| ^a Page 4-43. ^b Pollutant not detected in any sampling runs. EF is based on detection limits. ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |
| PAH EMISSION FACTORS | | | |
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Naphthalene | 2.53e-01 | 2.53e-07 | 4.45e-06 |
| Acenaphthylene | 5.31e-03 | 5.31e-09 | 9.34e-08 |
| Acenaphthene | 4.08e-02 | 4.08e-08 | 7.18e-07 |
| Fluorene | 8.84e-03 | 8.84e-09 | 1.56e-07 |
| Phenanthrene | 2.10e-01 | 2.10e-07 | 3.70e-06 |
| Anthracene | 6.17e-03 | 6.17e-09 | 1.09e-07 |
| Fluoranthene | 8.25e-02 | 8.25e-08 | 1.45e-06 |
| Pyrene | 3.73e-02 | 3.73e-08 | 6.56e-07 |
| Benz(a)anthracene | 4.68e-03 | 4.68e-09 | 8.23e-08 |
| Benzo(b,j,k)fluoranthene | 3.05e-03 | 3.05e-09 | 5.37e-08 |
| Benzo(a)pyrene | 2.09e-04 | 2.09e-10 | 3.68e-09 |
| Indeno(1,2,3-c,d)pyrene | 3.45e-04 | 3.45e-10 | 6.07e-09 |
| Benzo(g,h,i)perylene ^b | 5.19e-04 | 5.19e-10 | 9.13e-09 |
| ^a Page 4-43. ^b Pollutant not detected in any sampling runs. EF is based on detection limits. ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 44 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 34 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| DIOXINS/FURANS EMISSION FACTORS | | | |
|---|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| 2,3,7,8-TCDD | 8.14e-07 | 8.14e-13 | 1.43e-11 |
| Total TCDD | 9.29e-06 | 9.29e-12 | 1.63e-10 |
| Total PeCDD | 4.64e-06 | 4.64e-12 | 8.16e-11 |
| Total HxCDD | 2.10e-06 | 2.10e-12 | 3.70e-11 |
| Total HpCDD ^b | 1.86e-06 | 1.86e-12 | 3.27e-11 |
| Total OCDD | 1.10e-05 | 1.10e-11 | 1.94e-10 |
| 2,3,7,8-TCDF | 6.03e-06 | 6.03e-12 | 1.06e-10 |
| Total TCDF | 6.04e-05 | 6.04e-11 | 1.06e-09 |
| Total PeCDF | 4.74e-05 | 4.74e-11 | 8.34e-10 |
| Total HxCDF | 2.23e-05 | 2.23e-11 | 3.92e-10 |
| Total HpCDF | 6.95e-06 | 6.95e-12 | 1.22e-10 |
| Total OCDF | 1.86e-06 | 1.86e-12 | 3.27e-11 |
| ^a Page 4-45. ^b Pollutant not detected in any sampling runs. EF is based on detection limits. ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |
| ALDEHYDES/KETONES EMISSION FACTORS | | | |
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Formaldehyde ^b | 1.70e+00 | 1.70e-06 | 2.99e-05 |
| Acetaldehyde ^b | 1.09e+00 | 1.09e-06 | 1.92e-05 |
| Acrolein | 3.40e+00 | 3.40e-06 | 5.98e-05 |
| Methyl Ethyl Ketone ^b | 4.99e+00 | 4.99e-06 | 8.78e-05 |
| ^a Page 4-47, ESP Outlet data, only 189 HAPs. ^b Pollutant not detected in any sampling runs. EF is based on detection limits. ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 44 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 34 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| VOC EMISSION FACTORS | | | |
|---|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Chloroethane (ethyl chloride) | 2.50e+00 | 2.50e-06 | 4.40e-05 |
| Carbon Disulfide | 1.77e+01 | 1.77e-05 | 3.11e-04 |
| Methylene Chloride | 1.07e+01 | 1.07e-05 | 1.88e-04 |
| Hexane | 1.54e+00 | 1.54e-06 | 2.71e-05 |
| Vinyl acetate ^b | 4.29e-01 | 4.29e-07 | 7.55e-06 |
| 2-Butanone (Methyl Ethyl Ketone) | 1.64e+01 | 1.64e-05 | 2.89e-04 |
| Benzene | 1.03e-02 | 1.03e-08 | 1.81e-07 |
| Methyl Methacrylate | 1.14e+00 | 1.14e-06 | 2.01e-05 |
| Ethylene Dibromide ^c | 6.56e-02 | 6.56e-08 | 1.15e-06 |
| Toluene | 5.45e+00 | 5.45e-06 | 9.59e-05 |
| Tetrachloroethene (PCE) | 5.61e-01 | 5.61e-07 | 9.87e-06 |
| Chlorobenzene | 1.63e-01 | 1.63e-07 | 2.87e-06 |
| Ethylbenzene | 4.27e-01 | 4.27e-07 | 7.51e-06 |
| Xylenes(m/p + o) | 2.43e+00 | 2.43e-06 | 4.27e-05 |
| Styrene | 1.75e+00 | 1.75e-06 | 3.08e-05 |
| Cumene | 3.02e-01 | 3.02e-07 | 5.31e-06 |
| ^a Page 4-49. ^b Pollutant not detected in any sampling runs. EF is based on detection limits. ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 45 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 35 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: ASSESSMENT OF TOXIC EMISSIONS FROM A COAL FIRED
POWER PLANT UTILIZING AN ESP. FINAL REPORT-REVISION
1. ENERGY AND ENVIRONMENTAL RESEARCH
CORPORATION. IRVINE, CALIFORNIA. DECEMBER 23, 1993.

FACILITY: Brilliant, Ohio, Cardinal Unit 1
FILENAME DOE5.tbl

PROCESS DATA

| | |
|-----------------------------------|--|
| Coal type ^a | Bituminous |
| Boiler configuration ^b | Pulverized, Dry bottom |
| Coal source ^a | Pennsylvania |
| SCC | 10100202 |
| Control device 1 ^a | ESP |
| Control device 2 | None |
| Control device 3 | None |
| Data Quality | C (no HHV for the coal, had to use average from AP-42) |
| Process Parameters ^a | 615 |
| Test methods ^c | EPA, or EPA-approved, test methods |
| Number of test runs ^d | 3 |
| Coal HHV (Btu/lb) ^e | 13,000 |
| Coal HHV (Btu/ton) | 26,000,000 |
| Coal HHV (MMBtu/ton) | 26.0 |

^aPage 1-1.

^bPage 1-1 for "pulverized", assumed dry bottom.

^cPage 1-4.

^dPage 1-5.

^eAppendix A of AP-42, "Typical Parameters of Various Fuels".

METALS EMISSION FACTORS

| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^b (lb/ton) |
|-----------|---|-------------------------------|--|
| Aluminum | 235 | 2.35e-04 | 6.11e-03 |
| Calcium | 283 | 2.83e-04 | 7.36e-03 |
| Iron | 568 | 5.68e-04 | 1.48e-02 |
| Magnesium | 16.4 | 1.64e-05 | 4.26e-04 |

REFERENCE 45 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 35 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS EMISSION FACTORS | | | |
|--|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^b (lb/ton) |
| Phosphorous | 141 | 1.41e-04 | 3.67e-03 |
| Potassium | 88.7 | 8.87e-05 | 2.31e-03 |
| Silicon | 60.9 | 6.09e-05 | 1.58e-03 |
| Sodium | 249 | 2.49e-04 | 6.47e-03 |
| Titanium | 16.6 | 1.66e-05 | 4.32e-04 |
| Zinc | 18.3 | 1.83e-05 | 4.76e-04 |
| Antimony | 2.36 | 2.36e-06 | 6.14e-05 |
| Arsenic | 3.49 | 3.49e-06 | 9.07e-05 |
| Barium | 0.872 | 8.72e-07 | 2.27e-05 |
| Beryllium | 0.070 | 7.00e-08 | 1.82e-06 |
| Boron | 1,912 | 1.91e-03 | 4.97e-02 |
| Cadmium | 0.846 | 8.46e-07 | 2.20e-05 |
| Chromium | 7.51 | 7.51e-06 | 1.95e-04 |
| Cobalt | 0.631 | 6.31e-07 | 1.64e-05 |
| Copper | 1.39 | 1.39e-06 | 3.61e-05 |
| Lead | 3.83 | 3.83e-06 | 9.96e-05 |
| Manganese | 15.0 | 1.50e-05 | 3.90e-04 |
| Mercury | 0.448 | 4.48e-07 | 1.16e-05 |
| Molybdenum | 0.567 | 5.67e-07 | 1.47e-05 |
| Nickel | 4.72 | 4.72e-06 | 1.23e-04 |
| Selenium | 92.8 | 9.28e-05 | 2.41e-03 |
| Silver | 0.200 | 2.00e-07 | 5.20e-06 |
| Vanadium | 1.57 | 1.57e-06 | 4.08e-05 |
| ^a Page 1-11. | | | |
| ^b Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 45 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 35 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| DIOXINS/FURANS EMISSION FACTORS | | | |
|--|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^b (lb/ton) |
| Total TCDD | 5.15e-05 | 5.15e-11 | 1.34e-09 |
| Total HxCDD | 2.23e-05 | 2.23e-11 | 5.80e-10 |
| Total HpCDD | 7.61e-06 | 7.61e-12 | 1.98e-10 |
| Total OCDD | 2.03e-05 | 2.03e-11 | 5.28e-10 |
| 2,3,7,8-TCDF | 6.58e-07 | 6.58e-13 | 1.71e-11 |
| Total PeCDF | 2.79e-06 | 2.79e-12 | 7.25e-11 |
| Total HxCDF | 2.51e-05 | 2.51e-11 | 6.53e-10 |
| Total HpCDF | 2.68e-06 | 2.68e-12 | 6.97e-11 |
| Total OCDF | 1.07e-05 | 1.07e-11 | 2.78e-10 |
| ^a Page 1-11. | | | |
| ^b Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |
| SEMIVOLATILE ORGANICS EMISSION FACTORS | | | |
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^b (lb/ton) |
| Benzyl Chloride | 53.9 | 5.39e-05 | 1.40e-03 |
| Isophorone | 23.3 | 2.33e-05 | 6.06e-04 |
| Dimethyl Sulfate | 1.83 | 1.83e-06 | 4.76e-05 |
| Naphthalene | 1.94 | 1.94e-06 | 5.04e-05 |
| ^a Page 1-11. | | | |
| ^b Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |
| ORGANIC EMISSION FACTORS | | | |
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^b (lb/ton) |
| 2-Butanone (Methyl Ethyl Ketone) | 48.1 | 4.81e-05 | 1.25e-03 |
| Formaldehyde | 60.0 | 6.00e-05 | 1.56e-03 |
| Benzene | 3.40 | 3.40e-06 | 8.84e-05 |
| Bromomethane (Methyl Bromide) | 15.1 | 1.51e-05 | 3.93e-04 |
| Chloroform | 2.92 | 2.92e-06 | 7.59e-05 |
| Chloromethane (Methyl Chloride) | 6.38 | 6.38e-06 | 1.66e-04 |

REFERENCE 45 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 35 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| ORGANIC EMISSION FACTORS | | | |
|---|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^b (lb/ton) |
| Hexane | 6.53 | 6.53e-06 | 1.70e-04 |
| m,p-Xylene | 2.98 | 2.98e-06 | 7.75e-05 |
| Methyl Hydrazine | 6.57 | 6.57e-06 | 1.71e-04 |
| Methyl Tert Butyl Ether | 1.36 | 1.36e-06 | 3.54e-05 |
| Toluene | 5.16 | 5.16e-06 | 1.34e-04 |
| ^a Page 1-13. ^b Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |
| OTHER EMISSION FACTORS | | | |
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^b (lb/ton) |
| Ammonia | 40.7 | 4.07e-05 | 1.06e-03 |
| Chlorine | 1,547 | 1.55e-03 | 4.02e-02 |
| Hydrogen Chloride | 22,915 | 2.29e-02 | 5.96e-01 |
| Hydrogen Cyanide | 0.591 | 5.91e-07 | 1.54e-05 |
| Hydrogen Fluoride | 1,869 | 1.87e-03 | 4.86e-02 |
| CO | 753 | 7.53e-04 | 1.96e-02 |
| THC | 365 | 3.65e-04 | 9.49e-03 |
| NOX | | 1.22e+00 | 3.17e+01 |
| SOX | | 4.41e+00 | 1.15e+02 |
| ^a Page 1-14. Note that SOx and NOx units are lb/MMBtu. ^b Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 46 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 36 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: 500-MW DEMONSTRATION OF ADVANCED WALL-FIRED
COMBUSTION TECHNIQUES FOR THE REDUCTION OF
NITROGEN OXIDE (NOX) EMISSIONS FROM COAL-FIRED
BOILERS. RADIAN, CORPORATION, AUSTIN, TEXAS.

FACILITY: EPRI SITE 16
FILENAME SITE16.tbl

PROCESS DATA

| | |
|--|--|
| Coal type ^a | Bituminous |
| Boiler configuration ^b | Pulverized, dry bottom |
| Coal source ^f | Virginia/Kentucky |
| SCC | 10100202 |
| Control device 1 ^a | Low Nox Burners/Overfire Air (LNB/OFA) |
| Control device 2 ^a | ESP |
| Control device 3 | none |
| Data Quality | A |
| Process Parameters ^a | 500 MW |
| Test methods ^c | EPA, or EPA-approved, test methods |
| Number of test runs ^d | 3 |
| Coal HHV, dry (Btu/lb) ^e | 13,800 |
| Coal moisture percent by weight ^e | 3.8% |
| Coal HHV, as received (Btu/lb) | 13,295 |
| Coal HHV, as received (MMBtu/lb) | 0.013 |
| Coal HHV, as received (MMBtu/ton) | 26.59 |
| Coal feed rate (lb/hr,dry) ^e | 315,000 |
| Coal feed rate, as received, (lb/hr) | 327,443 |
| Coal feed rate, as received, (ton/hr) | 164 |

^aPage 2-1

^bConversation with Greg Behrens, Radian, Austin, Texas.

^cPage 3-1

^dPage 3-21, 3-22, 3-23

^ePage 3-7

^fAppendix B of EPRI Synthesis Report, page B-2

REFERENCE 46 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 36 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| STACK EMISSION FACTORS | | | |
|-----------------------------------|--|------------|----------|
| Pollutant | (lb/10 ¹² Btu) ^a | (lb/MMBtu) | (lb/ton) |
| Arsenic | 110 | 1.10e-04 | 2.92e-03 |
| Barium | 140 | 1.40e-04 | 3.72e-03 |
| Beryllium | 3.1 | 3.10e-06 | 8.24e-05 |
| Cadmium | 3.6 | 3.60e-06 | 9.57e-05 |
| Chloride | 15,000 | 1.50e-02 | 3.99e-01 |
| Chromium | 21 | 2.10e-05 | 5.58e-04 |
| Chrome VI | 5.4 | 5.40e-06 | 1.44e-04 |
| Cobalt | 6.5 | 6.50e-06 | 1.73e-04 |
| Copper | 30 | 3.00e-05 | 7.98e-04 |
| Fluoride | 5,100 | 5.10e-03 | 1.36e-01 |
| Lead | 11 | 1.10e-05 | 2.92e-04 |
| Manganese | 21 | 2.10e-05 | 5.58e-04 |
| Mercury | 4.8 | 4.80e-06 | 1.28e-04 |
| Molybdenum | 12 | 1.20e-05 | 3.19e-04 |
| Nickel | 17 | 1.70e-05 | 4.52e-04 |
| Phosphorous | 180 | 1.80e-04 | 4.79e-03 |
| Selenium | 140 | 1.40e-04 | 3.72e-03 |
| Vanadium | 41 | 4.10e-05 | 1.09e-03 |
| Benzene ^c | 0.51 | 5.10e-07 | 1.36e-05 |
| Toluene | 0.7 | 7.00e-07 | 1.86e-05 |
| Formaldehyde | 1.3 | 1.30e-06 | 3.46e-05 |
| Acenaphthene | 0.0081 | 8.10e-09 | 2.15e-07 |
| Acenaphthylene | 0.0030 | 3.00e-09 | 7.98e-08 |
| Anthracene | 0.0037 | 3.70e-09 | 9.84e-08 |
| Benzo(a)pyrene ^c | 0.0041 | 4.10e-09 | 1.09e-07 |
| Benzo(b,j,k)fluoranthenes | 0.0015 | 1.50e-09 | 3.99e-08 |
| Benzo(g,h,i)perylene ^c | 0.0031 | 3.10e-09 | 8.24e-08 |
| Benz(a)anthracene | 0.0070 | 7.00e-09 | 1.86e-07 |
| Chrysene | 0.0018 | 1.80e-09 | 4.79e-08 |

REFERENCE 46 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 36 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| STACK EMISSION FACTORS | | | |
|---|--|------------|----------|
| Pollutant | (lb/10 ¹² Btu) ^a | (lb/MMBtu) | (lb/ton) |
| Fluoranthene | 0.010 | 1.00e-08 | 2.66e-07 |
| Fluorene | 0.0099 | 9.90e-09 | 2.63e-07 |
| Indeno(1,2,3-c,d)pyrene ^b | 0.0027 | 2.70e-09 | 7.18e-08 |
| Phenanthrene | 0.044 | 4.40e-08 | 1.17e-06 |
| Pyrene | 0.011 | 1.10e-08 | 2.92e-07 |
| ^a Pages 3-24, 3-25. Individual run data on pages 3-21, 3-22, 3-23. | | | |

REFERENCE 47 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 37 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TEST REPORT TITLE: FIELD CHEMICAL EMISSIONS MONITORING REPORT:
SITE 122. SOUTHERN RESEARCH INSTITUTE, BIRMINGHAM,
ALABAMA. MAY, 1995.

FACILITY: EPRI SITE 122
FILENAME SITE122.tbl

| | |
|---|---------------------------------------|
| PROCESS DATA | |
| Coal type ^a | Bituminous |
| Boiler configuration ^a | Cyclone |
| Coal source ^a | Illinois |
| SCC | 10100203 |
| Control device 1 ^a | Electrostatic Precipitator, Cold side |
| Control device 2 ^a | none |
| Control device 3 ^a | none |
| Data Quality | A |
| Process Parameters ^a | 275 MW |
| Test methods ^b | EPA, or EPA-approved, test methods |
| Number of test runs ^c | 2 for manganese, 3 for all others |
| Coal HHV, as fired (Btu/lb) ^d | 12,327 |
| Coal HHV, as fired (Btu/ton) | 24,654,000 |
| Coal HHV, as fired (MMBtu/ton) | 24.7 |
| ^a Page 2-1. ^b Page 1-3. ^c Pages 3-17, 3-20 and 3-22. ^d Page 3-4. | |

REFERENCE 47 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 37 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| METALS, NONMETALS AND ORGANIC EMISSION FACTORS | | | |
|---|---|-------------------------------|--|
| Pollutant | Emission Factor ^a (lb/10 ¹² Btu) | Emission Factor (lb/MMBtu) | Emission Factor ^c (lb/ton) |
| Arsenic | 220 | 2.20e-04 | 5.42e-03 |
| Barium | 69 | 6.90e-05 | 1.70e-03 |
| Beryllium | 4.0 | 4.00e-06 | 9.86e-05 |
| Cadmium | 3.6 | 3.60e-06 | 8.88e-05 |
| Chromium | 100 | 1.00e-04 | 2.47e-03 |
| Cobalt | 26 | 2.60e-05 | 6.41e-04 |
| Lead | 180 | 1.80e-04 | 4.44e-03 |
| Manganese ^b | 205 | 2.05e-04 | 5.05e-03 |
| Mercury | 8.2 | 8.20e-06 | 2.02e-04 |
| Nickel | 71 | 7.10e-05 | 1.75e-03 |
| Selenium | 67 | 6.70e-05 | 1.65e-03 |
| Vanadium | 148 | 1.48e-04 | 3.65e-03 |
| Fluorine | 3.8e+03 | 3.80e-03 | 9.37e-02 |
| Chlorine | 2.3e+05 | 2.30e-01 | 5.67e+00 |
| Sulfur (sulfur dioxide) | 1.5e+06 | 1.50e+00 | 3.70e+01 |
| Formaldehyde | 0.7 | 7.00e-07 | 1.73e-05 |
| Benzene | 7.8 | 7.80e-06 | 1.92e-04 |
| Toluene | 1.9 | 1.90e-06 | 4.68e-05 |
| ^a Page 3-30. ^b EF developed from two sampling runs. See footnote c to Table 3.10, page 3-17. ^c Multiply emission factor, lb/MMBtu, by coal HHV, MMBtu/ton. | | | |

REFERENCE 48 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 38 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

TITLE: Hydrogen Chloride and Hydrogen Fluoride Emission Factors for the NAPAP Emission Inventory. EPA-600/7-85-041. October, 1985.

Filename: NAPAP.tbl

| BOILER SCC DESCRIPTIONS | Source Classification Codes | | Hydrogen Chloride (lb/ton) ^{a,b} | | Hydrogen Fluoride (lb/ton) ^{a,b} |
|--|-----------------------------------|---|---|---|---|
| Commercial/Industrial Boilers | | | | | |
| Bituminous and Subbituminous Coal | | | | | |
| Firing Types | | | | | |
| Pulverized Coal Wet Bottom | 1-03-002-05/21 | * | 1.48 | * | 0.17 |
| Pulverized Coal Dry Bottom | 1-03-002-06/22 | | | | |
| Overfeed Stoker | 1-03-002-07 | | | | |
| Underfeed Stoker | 1-03-002-08 | | | | |
| Spreader Stoker | 1-03-002-09/24 | | | | |
| Hand-fired | 1-03-002-14 | | | | |
| Pulverized Coal Dry Bottom Tangential | 1-03-002-16/26 | | | | |
| Atmospheric Fluidized Bed Combustor | 1-03-002-17/18 | | | | |
| Cyclone Furnace | 1-03-002-23 | | | | |
| Traveling Grate Overfeed Stoker | 1-03-002-25 | | | | |
| Electric Generation & Industrial Boilers | | | | | |
| Bituminous and Subbituminous Coal | | | | | |
| Firing Types | | | | | |
| Pulverized Coal Wet Bottom | 1-01-002-01/21 | * | 1.9 | * | 0.23 |
| | 1-02-002-01/21 | | | | |
| Pulverized Coal Dry Bottom | 1-01-002-02/22 | | | | |
| | 1-02-002-02/22 | | | | |
| Cyclone Furnace | 1-01-002-03/23 | | | | |
| | 1-02-002-03/23 | | | | |
| Spreader Stoker | 1-01-002-04/24 | | | | |
| | 1-02-002-04/24 | | | | |

REFERENCE 48 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 38 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| BOILER SCC DESCRIPTIONS | Source Classification Codes | Hydrogen Chloride (lb/ton) ^{a,b} | Hydrogen Fluoride (lb/ton) ^{a,b} |
|--|-----------------------------------|---|---|
| Traveling Grate Overfeed Stoker | 1-01-002-05/25 | | |
| | 1-02-002-25 | | |
| Overfeed Stoker | 1-02-002-05 | | |
| Pulverized Coal Dry Bottom, | 1-01-002-12/26 | | |
| Tangential Firing | 1-02-002-12 | | |
| Atmospheric Fluidized Bed | 1-01-002-17 | | |
| | 1-01-002-18 | | |
| | 1-02-002-17 | | |
| | 1-02-002-18 | | |
| Underfeed Stoker | 1-02-002-06 | | |
| Commercial/Industrial Boilers | | | |
| Lignite | | | |
| Firing Types | | | |
| Pulverized Coal | 1-03-003-05 | * 0.351 * | 0.063 |
| Pulverized Coal Tangential Firing | 1-03-003-06 | | |
| Traveling Grate Overfeed Stoker | 1-03-003-07 | | |
| Spreader Stoker | 1-03-003-09 | | |
| Electric Generation & Industrial Boilers | | | |
| Lignite | | | |
| Firing Types | | | |
| Pulverized Coal | 1-01-003-01 | 0.01 | 0.01 |
| | 1-02-003-01 | | |
| Pulverized Coal Tangential Firing | 1-01-003-02 | | |
| | 1-02-003-02 | | |
| Cyclone Furnace | 1-01-003-03 | | |
| | 1-02-003-03 | | |

REFERENCE 48 OF AP-42 SECTION 1.1 BACKGROUND DOCUMENTATION
REFERENCE 38 OF AP-42 SECTION 1.7 BACKGROUND DOCUMENTATION

| BOILER SCC DESCRIPTIONS | Source Classification Codes | Hydrogen Chloride (lb/ton) ^{a,b} | Hydrogen Fluoride (lb/ton) ^{a,b} |
|---|-----------------------------------|---|---|
| Traveling Grate Overfeed Stoker | 1-01-003-04 | | |
| | 1-02-003-04 | | |
| Spreader Stoker | 1-01-003-06 | | |
| | 1-02-003-06 | | |
| | Overall Average | 1.2 | 0.15 |
| | Quality Rating | B | B |
| ^a Pages 29, 30, 31. Factors are for both uncontrolled and controlled boilers. ^b An asterisk to the left of a factor indicates that it was used in calculating the overall emission factor. | | | |